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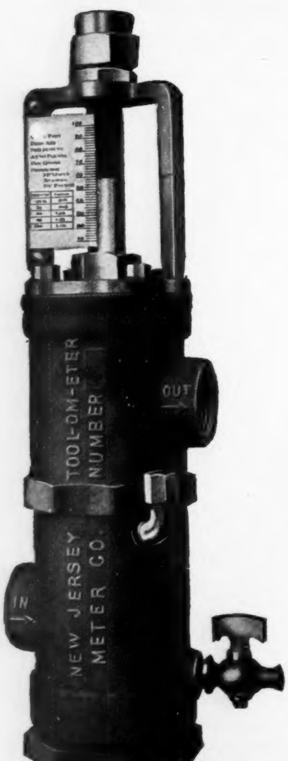
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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XXI JUNE, 1916 No. 6

SPEED AND ECONOMY OF THE DEEP HOLE DRILL WAGON

BY CHARLES A. HIRSCHBERG.

Sufficient time has elapsed since the introduction of the first deep-hole drilling rig about five years ago to determine definitely the fitness of such apparatus for use in rock excavation. An analysis of the uses to which it has been successfully put, and the results accomplished, demonstrate conclusively that such work as the excavation of rock in deep crushed-rock quarries, extensive railroad cuts and canal work is the especial field of the deep-hole drilling rig.

The main problem presented by such work —the rapid breaking up of large areas of rock —is such that the ordinary type of drilling machine mounted on a tripod will not do, for, if the latter is light enough to permit of easy and quick mobility, it is not powerful enough to drill the depth and diameter of holes necessary to rapid and economical excavation in this class of work. If, on the other hand, heavy enough tripod drills are employed, they lack quick mobility, and the time consumed and difficulties encountered in this respect make the operation of resetting for each hole slow and expensive.

The deep-hole rig, with its means for traction and ability to drill a number of holes at one setting, at once permits the employment of powerful drilling machines and eliminates a large portion of the dead time of resetting.

An idea of the economy which obtains, in labor alone, with these drilling rigs may be had when it is understood that they will drill from 150 to 250 ft. of large diameter hole per day with a crew of three men. With the tripod method the footage rarely exceeds 70 ft., and is more often as low as 60 ft. It would, therefore, require from three to four tripod drills to accomplish as much work, or from three to four times the labor and, of course, a proportionately greater amount of power.

Large diameter holes permit heavy powder loading, making springing unnecessary. This again means a material saving, as the springing of holes requires extra powder, extra labor, and in a great many cases results in the partial loss of holes, due to their becoming filled with muck in the springing process.

The progression of drilling with a deep-hole rig is shown in Fig. 1. The drill frame is swung at right angles to the line of progress, the jack-screw set, and a hole drilled. The drill is then raised and swung parallel with the line of progress and another hole drilled. Again the drill is raised and swung

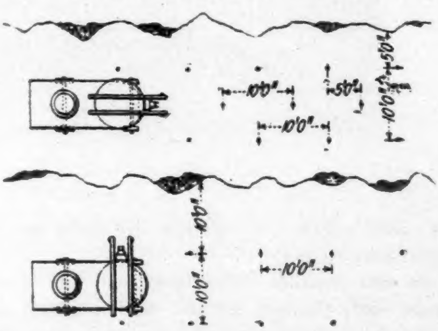


FIG. 1.

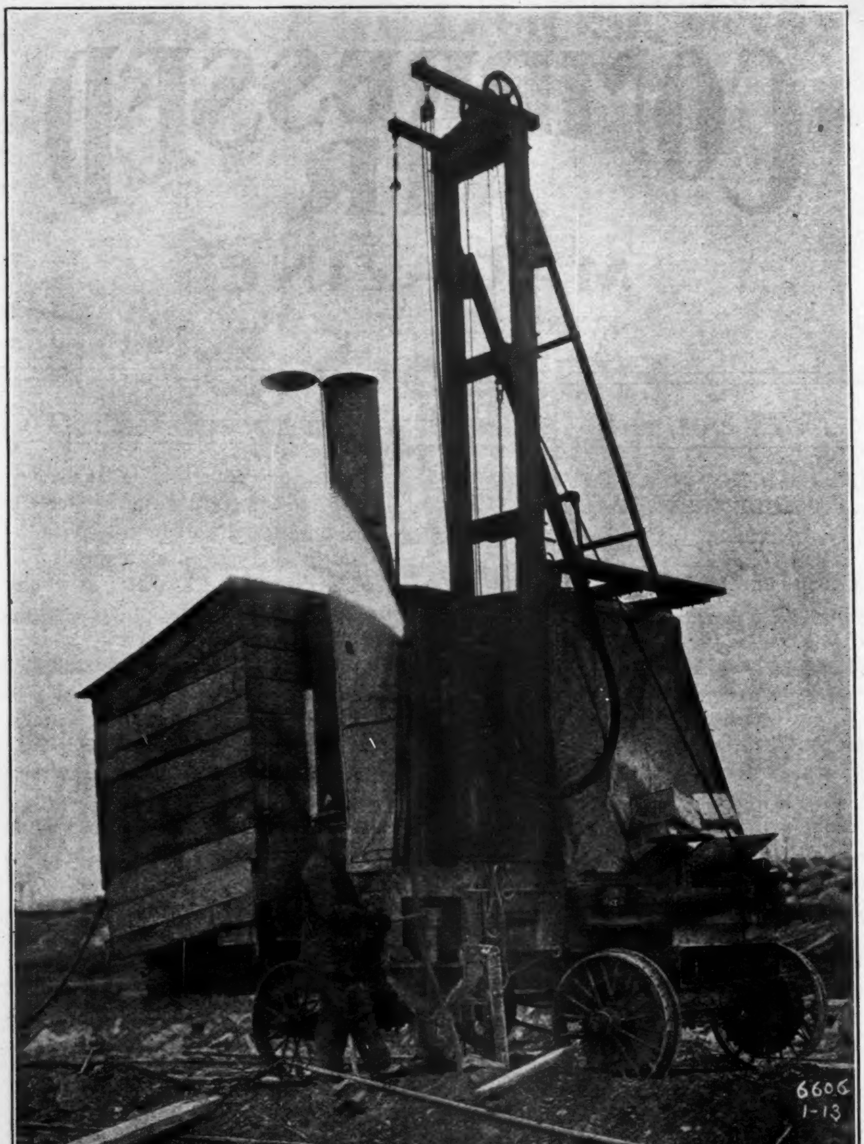


FIG. 2.

at right angles, to the opposite side, and a third hole drilled.

In this manner three holes are put down from each position of the machine, two on a line at right angles, the distance apart depending upon the sweep of the drill frame, and one-half this distance in advance of or behind the others, and on a line midway between them. The drill wagon is then moved forward or back the proper distance and the operations repeated. When the required length has been covered, the drill is moved over and

another triple row of holes, paralleling the first, put down, and so on continuously. Blasting is generally begun after sufficient ground has been drilled, while drilling progresses further on.

For successful drilling of deep holes it is necessary to provide a means for freeing the hole of cuttings during drilling operations. For this purpose a water jet is provided which is placed in the hole alongside the drill steel. turntable, where he has control over the operation of the drill. The helper tends to the water jet and steel, lowering the pipe with the steel. As soon as a hole is finished a wooden plug is dropped into it, to keep it clear until ready for loading.

TYPICAL INSTALLATIONS.

A few typical installations and records of accomplishment are described in the following.

TABLE 1—PROGRESS WITH 15-FOOT FEED WAGON DRILLS ON CALUMET SAG CHANNEL OF CHICAGO DRAINAGE CANAL

	No. of 10-hour shifts	No. of Holes	Total Lineal Feet	Av. per shift
July, 1912	9	173	1,453	161
August, 1912	31	563	4,947	160
September, 1912....	50	1,051	8,512	170
October, 1912......	54	1,052	8,968	166
November, 1912....	49	537	6,197	126
December, 1912. ..	45	442	6,184	137
January, 1913......	47	750	6,809	145
February, 1913....	35	699	5,783	165
March, 1913 (2d lift)	38	643	4,909	129
April, 1913	52	796	10,464	201
May, 1913..........	54	897	10,820	200
June, 1913..........	54.9	1,016	13,287	244
July, 1913..........	50	838	10,679	213
August, 1913.......	49.6	980	11,179	225
September, 1913...	52	984	12,170	234
October, 1913.......	58.4	1,177	14,293	245
November, 1913....	50	739	10,679	214
December, 1913....	46.8	635	9,058	193
January, 1914......	36.9	533	7,304	200
February, 1914....	...	...	......	...
March, 1914........	16	219	2,974	185
April, 1914.........	50.5	910	11,629	230
May, 1914..........	52	1,040	12,434	239
June, 1914..........	50.4	973	11,245	223
July, 1914..........	54.8	1,044	12,411	226
August, 1914.......	84	1,445	18,219	217
September, 1914....	37	676	7,117	192
November, 1914....	..	...	.....	...
December, 1914....	12	12	2,565	211
March, 1915........	12.6	173	2,422	192
April, 1915.........	20.7	343	4,768	230

Average feet per drill per 10-hour day for entire 2½ years = 199.1.

A pipe about ½ in. in diameter is suspended from the top of the derrick, which can be raised or lowered to suit the position of the drill bit. This pipe is connected by means of rubber hose with either a pump mounted on the top of the drill wagon turntable, the pump suction being connected to any convenient water supply, or to a water pressure line. The amount of water fed into the hole is under the control of the operator.

In operating, the drill runner stands on the

Sixteen deep hole drill wagons were used on the Champlain Barge Canal, working ahead of a Marion steam shovel. The holes drilled averaged 12 ft. in depth and 4 in. in diameter. They were spaced on 5 and 10-ft. centers. Each hole was drilled with one length of steel. The average drill hole footage per shift, for each drilling rig was between 160 and 200 ft.

On the Calumet Sag Channel of the Chicago Drainage Canal the contractors employed two 15-ft. feed steam wagon drills, Fig. 2. The

Table 2—Progress with 20-Foot Feed Wagon Drills

July 11 to Dec., 1914, and Feb. 22 to Aug. 8, 1915.

	Total lin. feet	Av. per shift	Max. shift	Min. shift
1914				
Drill No. 1—130 day shifts (10 hr.)	27,739	213.4	425 ft.	68 ft.
Drill No. 1—49 night shifts (10 hr.)	7,347	149.9	264 ft.	17 ft.
Drill No. 2—112 day shifts (10 hr.)	28,174	251.5	425 ft.	85 ft.
Drill No. 2—30 night shifts (10 hr.)	4,129	137.6	272 ft.	34 ft.
1915				
Drill No. 1—142 day shifts (10 hr.)	37,658	265.1	475 ft.	64 ft.
Drill No. 2—139 day shifts (10 hr.)	38,335	275.8	510 ft.	51 ft.

rock encountered in this work was hard Lemont limestone with flint strata. The excavation was made in three lifts, holes averaging 11 ft. 9 in. in depth and 3¼ in. in diameter. Two-inch hexagonal steel with cross-bits was used. The first lift was very much broken; the second and third lifts were solid. Table 1 shows the drilling progress made by the contractors under these conditions.

Another contractor secured the following results, Table 2, with two 20-ft. feed, steam wagon drills. The rock on this contract was hard Lemont limestone with flinty strata and containing horizontal seams filled with a cementaceous mud. In many places the rock was very shattered. The holes averaged 17 ft. in depth and 3½ in. in diameter. Two-inch hexagonal steel with cross-bits was used.

The wagon drill, Fig. 3, employed in the quarry at Valhalla, N. Y., of H. S. Kerbaugh, Inc., contractors for the Kensico dam of the Catskill Aqueduct, was of the electric-air type, taking current from wires strung in the quarry. The holes drilled averaged 50 ft. in depth, bottoming 3 in. in diameter, and 30 ft., bottoming 4½ in. in diameter. Under test conditions 104 ft. of hole was drilled per shift.

It has been estimated that the cost per foot, based upon power and labor charges alone, on an average day's work of 50 ft. of hole (which was very conservative) approximated 14 cents per foot. The extraordinary feature, however, was the power cost. This sometimes ran as low as 30 cents per day and never exceeded 70 cents. Fig. 4 shows a series of holes drilled and prepared for blasting in the Kensico quarry. It is surprising to note that the work was done by this type of rig on ground with a decided grade and irregular in contour.

Contractors on the United States Govern-

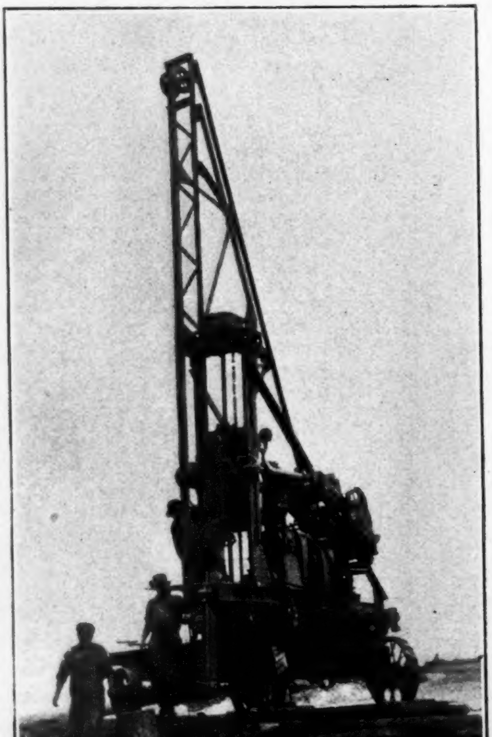


FIG. 3.

FIG. 4.

ment Locks at Sault Ste Marie, Mich., employed four 18-ft. steam wagon drills. The rock drilled was Potsdam sandstone, considerably broken and containing many mud seams. Holes varied in depth from 18 to 27 ft. All holes bottomed 4¼ to 4½ in. in diameter. Cuttings would not mix satisfactorily with water and they were therefore drilled dry and a ⅜-in. jet of air at 100 lb. pressure was used to clean the holes.

Prior to the installation of these four wagon drills, fifty tripod drills were used, but could not keep ahead of the steam shovels. The four wagon drills which displaced them were 1,000 ft. ahead of the shovels within three months after installation.

Table 3 gives the record of each traction drill working three shifts during July, 1913. Each drill ran three eight-hour shifts except where indicated.

A drill wagon was put to a rather novel use by Smith & McCormick, contractors, several years ago in repairing a heavy concrete bridge or arch over a tunnel of the Erie Railroad at Bergen Hill, N. J. Holes were drilled varying in depth from not less than 40 to more than 50 ft. in the concrete structure, which was of heterogeneous nature, comprising rough stones, more or less iron and other rubbish compacted with occasional loose or unfilled spaces, and, as a result, presented considerable drilling difficulties.

The purpose of the holes was to permit of pouring cement grouting to solidify the concrete mass, which had developed numerous cracks after completion.

FIVE CHURN DRILLS SUPERSEDED.

During last year the Dewey Portland Cement Company of Dewey, Okla., installed a steam wagon drill for work in its cement quarry. Up to that time this drilling had been done with five churn drills, which were displaced.

The first row of holes was drilled within 10 ft. of the quarry face, this distance being sometimes increased to 15 ft. A second row of holes was drilled 10 ft. back of the first row. Holes were spaced 10 ft. apart in the rows. All holes were drilled with a single steel to a depth of 20 ft., bottoming 3½ in. An average drilling progress of ten and sometimes eleven holes per day obtained. In blasting, from thirty to fifty holes were exploded at one time.

The drilling crew consisted of three men receiving the following wages: Main operator $3 and two helpers $2 each per ten-hour day. No accurate record was kept of the coal consumption, but this was estimated to be 1,300 lb. per day, costing $3 per ton

TABLE 3—ROCK DRILLING AT SAULT STE. MARIE

Date	No. 1	No. 2	No. 3	No. 4
1	194	136	120	272
2	254	85	200	306
3	194	170	200	234
7	207	100	126	252
8	253	176	136	270
9	209	256	187	288
10	240	†68	143	198
11	*144	*153	*85	108
12	†25	...	156	...
14	150	194	270	*119
15	100	216	154	234
16	†25	180	126	171
17	*125	216	221	304
18	*100	306	264	313
19	*125	270	*119	213
21	*85	198	187	304
22	*156	*108	*95	144
23	153	162	160	272
24	*136	180	172	240
25	121	198	†36	240
26	*106	*119	198	352
28	*228	†102	126	206
29	260	272	198	255
30	260	*85	220	204
31	*120	*187	†40	*152
Total	3,990	4,136	3,939	5.652
Average per shift	65.4	62.6	58	79.7

*Two shifts.
†One shift.

delivered. Based on the foregoing costs and including the items of maintenance and depreciation, the cost per foot of hole drilled was 7½ cents per foot. This cost compares with 25 cents per foot for the churn drills formerly used.

It was further found that, owing to the ability to place the holes better, blockholing was reduced about 50 per cent.

A PNEUMATIC INCIDENT

A country girl from the lower part of South Carolina—they call them Crackers down there—went to Savannah to pay her first visit to a dentist. The dentist found a jaw tooth badly in need of his services. He drilled away the decayed spots, and then, to clear the cavity of small particles, brought into use a small hand bulb. As the first gush through the blowpipe struck her mouth, the patient flinched.

"Can you feel that air?" inquired the dentist.

The young woman gazed up at him, puzzled. "That air what?" she inquired simply.

—*Saturday Evening Post.*

LIGHTING THE PANAMA CANAL

The United States is largely indebted to the efforts of Swedish engineers for an economical means of lighting the Panama Canal. In Sweden the reefs and narrow inlets are a menace to skippers and fishermen, but the expense of engaging lighthouse keepers and providing them with the means of livelihood would be so great that many dangerous points had necessarily to be left unguarded. That resulted in Gustaf Dalen creating the self-tending lamp, which affords a practical and economical means of light. From that was finally evolved the Aga gas accumulator, which contains 100 times its own volume of gas, and is, at the same time, safe and nonexplosive. It can be fixed to burn for a year or even a longer time without personal attention. The Aga flashlight apparatus also makes it possible to give distinctive characteristics to lights, of any desired duration or combination, while another marvel of this economical device is the sunvalve, which extinguishes the light during the day.

HAND DRILLS IN STRUCTURAL WORK

BY CHARLES C. PHELPS.

A laborer with a chisel or a pipe-bit and hammer can drill holes of small diameter in concrete at an average rate of about 1 ft. per hr. In brick the rate of cutting is faster. It is thus apparent that the hand method is almost prohibitive in cost under many circumstances, and would be out of the question if a large number of holes had to be cut in a short time. Various types of rock drills are well adapted to work of this character and, in fact, have been so applied with marked economies in several instances.

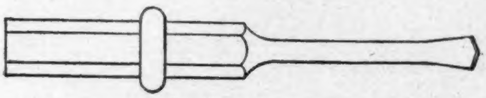


FIG. 1.

A notable job of this nature was the drilling of approximately 9,500 window-bolt holes at the reconstructed Edison Phonograph Works, West Orange, N. J., following the disastrous fire in December, 1914. Each bay required 17 expansion bolts to hold the fireproof steel window frame. It was necessary to drill a hole 3½ in. deep by ¾ in. in diameter in the concrete walls, to accommodate each bolt. These holes necessitated both horizontal and vertical drilling. For the purpose a Jackhamer with a special bit of hexagon steel (Fig 1) was employed. Two men handled the drill, one holding the drill itself and the other guiding the bit (Fig. 2). They averaged 500 holes per day, their work including the frequent moving of scaffold and the changing of air connections. This figure reduces to 15 or 16 ft. of hole drilled per hr. The Jackhamer was used for drilling both horizontal and vertical holes, but many of the up-holes were drilled with a butterfly stope drill (Fig. 3). Both of these drills were employed also for drilling holes preparatory to removing some of the concrete construction.

FIG. 2.

FIG. 3.

This is a good illustration of a large number of small anchor-bolt holes drilled economically. An example of a number of large anchor-bolt holes bored at low cost is found in the Quebec Bridge. There were 176 of these holes, 5 ft. deep by 4½ in. in diameter, drilled in granite masonry with a Calyx chilled-shot core-drill.

MISCELLANEOUS USES FOR HAND HAMMER DRILLS.

Drilling holes in machinery foundations for hold-down bolts; in floors for railings; in

walls or ceilings for pipe, wire, shafting, conduit brackets or hangers, and lighting fixtures; and in walls of buildings for fire-escape brackets, are other uses to which pneumatic drills and hammers have been applied with advantage. They are equally valuable for such other applications as cutting openings in floors or walls for windows and doors, shafting, belting, pipes, wires, etc., and for cutting channels in concrete floors or ceilings.

A Jackhamer has seen considerable service along these lines at the Government Printing Office in Washington. The floor construction there is of concrete and brick arches, and the ceilings are constructed of concrete tiles. The space between floor and ceiling is used for piping, electric wires, etc., and it is often necessary to cut holes in floor or ceiling when installing machinery or lights, the Jackhamer being employed for the purpose. The drill takes its air from the regular 50-lb. air lines in the Printing Office. When cutting concrete flooring, one man can drill a hole through the floor (10 to 10½ in. thick) in 2½ min. Ladders or staging are required for ceiling work, and for such work two men handle the drill. The automatically rotated type of drill is especially well adapted for use where footing is insecure or elbow room restricted, as on ladders, falsework or swinging scaffolds.

In another case where hanger holes were drilled in rock it formerly required a whole day for two men with hammer and steel to drill 9 or 10 holes, each 4 to 6 in. in depth, whereas now one man drills the same number of holes in 10 to 15 minutes with a hand hammer drill.

Hundreds of elevated-railway column foundations are being removed in New York with the aid of Jackhamers. These brick footings are located above the new subway in the lower part of the city. They will be replaced by concrete foundations. These footings are in the shape of truncated pyramids 8 or more feet high and about 4 ft. square on top. Fig. 4 shows three of these foundations partly uncovered before removal. After the elevated structure has been supported on falsework, holes are drilled from 12 to 20 in. in depth. The brick is then broken out with sledge-and-wedge.

One of the earlier applications of plug drills for work of this nature was for cutting out concrete and brickwork at the New York end of the Brooklyn Bridge, to make room for a subway terminal. Hammer drills of the non-rotating butterfly type were used, as the more suitable automatically rotated drills had not been developed at that time. The work necessitated cutting through, first, an 18-in. layer of fine cement concrete; next, about 3 ft. of rough gravel concrete; and finally the brick supporting arches or vaulting. The material was cut away in layers or benches—first, the top layer, which, though hard, was fairly uniform and good cutting; next, the rough concrete, which was very difficult to cut; and then the brick, which was comparatively easy cutting. In one instance it was found necessary to cut through a steel tie. This was accomplished with the same drill steel as was used for the concrete, in the surprisingly short time of 12 min. Blasting was prohibited in this confined place—so close to one of the most congested of traffic arteries—and these drills were called upon to pick out all the material piece by piece. For this work a solid hexagon steel with narrow-pointed chisel about ¾ in. across the cutting edge was employed.

A tunnel is being constructed in Seattle to connect the King County courthouse with the City Hall. This work necessitates the removal of large concrete foundations, for which purpose a Jackhamer is employed. This drill was observed to work at as fast a rate as 1 ft. per min.

Large concrete foundations were removed by this method at the Brighton (England) Corporation Electric Works. The concrete was exceptionally hard, and many of the broken blocks weighed as much as 20 tons each. An ordinary chisel bit 20 in. in length was employed for drilling holes all around the foundation, about 9 in. apart and 18 in. deep. The average speed of drilling was 7 holes per hour—that is, about 10 ft. of hole per hour.

When holes are drilled dry in concrete with hand-rotated tools, the natural moisture present in the concrete seems to cause dust from the cuttings to pack and form a mud collar above the bit, making it necessary to withdraw the steel by means of a wrench, which causes considerable delay. This difficulty is not encountered with the automatically rotated type of drill, because its air jet keeps the hole clean and the steel can easily be withdrawn by means of its holder.—*Engineering News.*

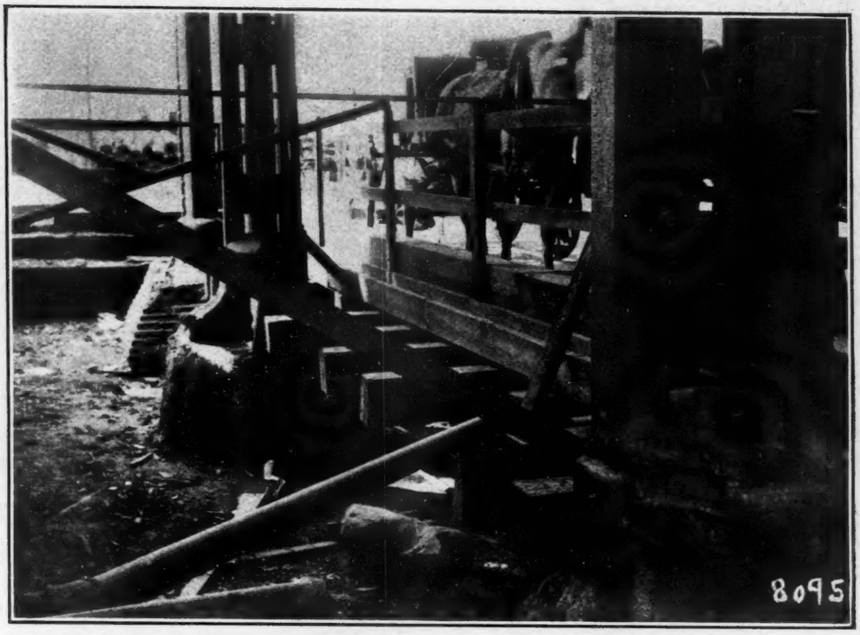


FIG. 4.

HEART ACTION AT GREAT ALTITUDES

The following conclusions, as the result of extensive observation and experiment, are contributed to *La Presse Medical* by Dr. G. Ferry:

The pulse becomes more and more rapid from the ground up to a height of 750 meters. From this height to 1,250 meters it still augments, but less rapidly. Above this height it again accelerates more rapidly. The period of slower acceleration seems to be explained by the fact that between 750 meters and 1,250 meters the air is usually calmer than at lower altitudes, and the wind more regular. Above this height the cold becomes a great factor in acceleration. Each time a gust strikes the aeroplane the pulse accelerates. During a flight at a particular altitude the pulse remains constant. When descent begins there is a gain for a very short period a quickening of the pulse, due, it is thought, to the thrill of excitement experienced when the engine is shut off. After this the frequency falls in a regular manner during a slow descent. Each "event" in the descent causes an acceleration, short, but definite. The pulse at the end of the flight is always more rapid than at the beginning.

VALUE OF BELT TIGHTENERS

Professor William W. Bird, of Worcester Polytechnic Institute, with Francis W. Roys, have been experimentally investigating the effects of atmospheric humidity upon oak tanned leather belting, with the following definite conclusions:

1. If a belt be set up at a low relative humidity, slipping will occur with a marked rise in the humidity, especially if it is accompanied with a rise in temperature.

2. If a belt be set up at a high relative humidity, excessive stretching and excessive pressure on the bearings will result from a decided decrease in the relative humidity, especially if accompanied by a fall in temperature.

3. If a belt be set up at a medium relative humidity the tensions will not be excessive at low relative humidities nor will there be any great danger of slipping at high relative humidities unless accompanied by excessive temperature changes.

4. If a belt be set up at any relative humidity with a spring or gravity tightener, a load 50 per cent. greater than the standard can be transmitted at either high or low humidity without any of the troubles.

A SUCCESSFUL SMALL AIR LIFT

BY H. L. HICKS.

The air lift is widely recognized as a most convenient and effective means of raising water from deep wells, and in many cases it is practically the only device which can be employed. It has generally been considered, however, that it is impracticable to employ the same means for raising water to any considerable distance above the well and especially for conveying water horizontally or in any direction involving sharp turns in the piping.

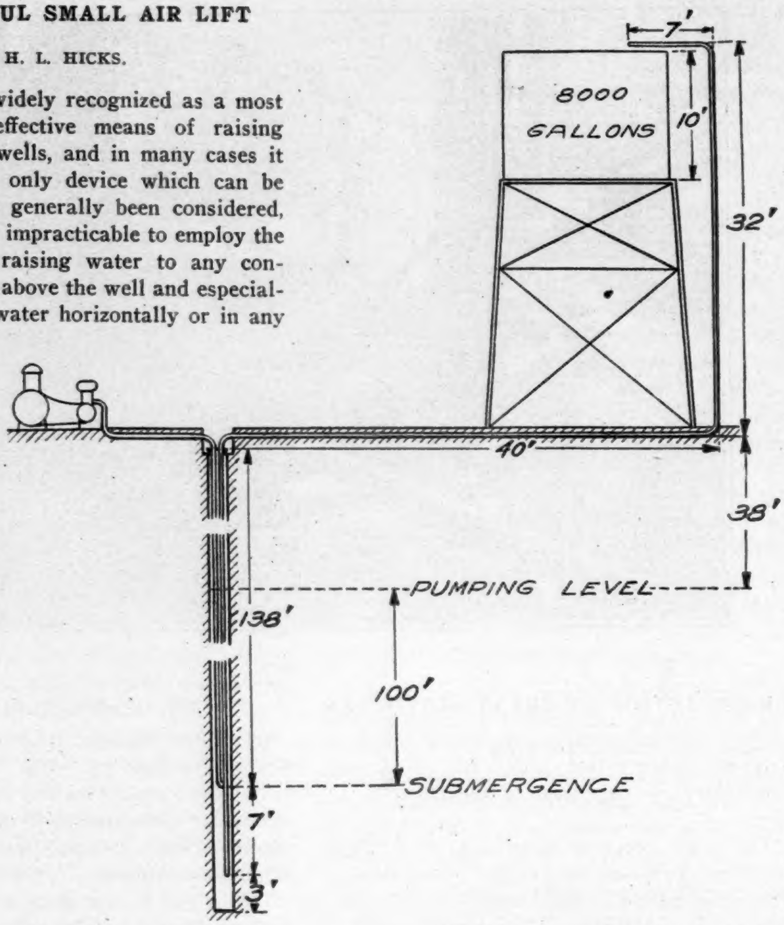


FIG. 2.

The installation pictured in Fig. 1, and shown diagrammatically in Fig. 2, is one that does accomplish this. Water is lifted, in continuous flow, from 35 to 44 ft. (depending on the season), is delivered a horizontal distance of 40 ft., elevated another vertical lift of 30 ft., and discharged after a second run of 7 ft. There are 3 right-angle bends in this eduction pipe. It is a good performance and shows the possibilities of a carefully designed air lift.

This plant is installed on a farm in Antelope Valley, California, and furnishes water for domestic purposes. The single well is 6 in. in diameter and 150 ft. deep. It was formerly pumped with a draw valve pump, and when this was removed the well was found to have become filled with sand to a depth of 70 ft. Upon the installation of the air lift, however, the sand was quickly removed without experiencing any difficulty. As a matter of fact, accumulation of sand is not possible with the air lift in operation.

The water level in the well varies slightly, the static head being 31 to 40 ft., according to the season. The average level is about 38 ft., with a pumping drop of 4 ft. Water is elevated to an 8,000-gal. tank 30 ft. from the ground, making a total life of 70 ft.

The top of the well is 2 ft. below ground level and both air and water pipes are buried for protection. The discharge pipe is 2 in. in diameter and extends to within 3 ft. of the

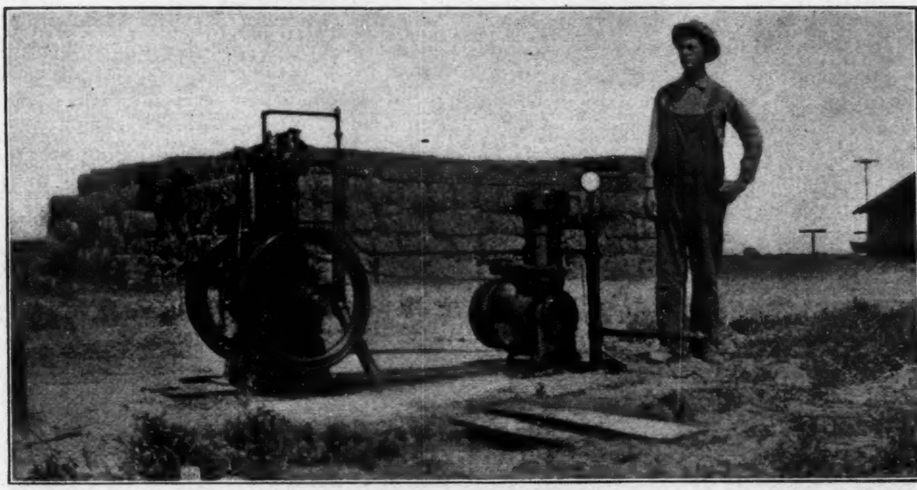


FIG. 1.

bottom of the well. It is fitted with a Lane Standard footpiece placed 7 ft. above the end of discharge pipe. The air supply pipe is ¾ in. in diameter. The running submergence is 100 ft. or about 59 per cent.

Air is supplied by an Ingersoll-Rand, 3½ by 4-in. Imperial vertical compressor with hopper cooled cylinder. This is belted to a Nonpareil, 2-hp. gasoline engine operating at 400 r.p.m. The belt pulleys of compressor and engine are 16 and 20 in. respectively, giving a compressor speed of 500 r.p.m. The air consumption is 11 cu. ft. of free air per minute at a pressure of 55 lb. per sq. in. This is based on a normal pressure of 44 lb. and a friction loss in the long discharge line of 25 per cent. The delivery is 39.8 gal. per min. with an operating efficiency of 35 per cent.

As Fig. 1 shows, the wonderful climate of this particular section of the country has permitted the installation of the air compressing plant in the open, certainly an economy as far as the cost of housing goes.

This plant was designed by J. Warren Lane and installed for Mrs. Mae Whidden Taylor, Lancaster, Cal., by Harry Lee Martin.—*Practical Engineer.*

Raising oil from wells by air-lifts may be more satisfactory than by using pumps. An air-lift is suited to raising liquid containing sand, mud, or slime. At Bakersfield, California, an air-lift in one oil-well raised oil 1,200 ft. with subergence of only 30%.

A HILARITY COMPRESSOR

An Imperial, Type XII, air compressor is being installed at Luna Park, Cleveland, Ohio, to furnish a supply of compressed air for Hilarity Hall, a novel attraction of this popular amusement resort. Some interesting information concerning this installation and its responsibilities is furnished us by Mr. W. A. Armstrong of Cleveland.

Among numerous other specialties in this Hilarity Hall is a novel diversion arranged for the people in the form of local jets of compressed air attacking the person of the visitor at different points of his anatomy. The compressor is installed and operated in the usual manner (and of course not visible in the hall) and connections are led from the receiver to various openings located throughout the hall. These openings are in the floor, in the walls, in the faces of square posts or pillars. These pillars are decorated with comic post cards and other devices to draw the unwary close to them and when the opportunity is ripe an operator in a central box pulls a lever and shoots the victim full of compressed air much to his surprise and mild discomfiture, but absolutely without harm.

The greatest excitement, however, developes when a lady incautiously pauses over one of the floor openings. This is the operator's golden opportunity and he cuts loose with a jet of air which whisks her draperies upward

to an interesting height, bringing out a squeal to be heard several blocks away. No accurate data are yet at hand as to the volume of air required for the skirt lifting operation, but no doubt formulas will develope. It must be realized that such data would necessarily be subject to continual change with the fluctuations of fashions, tight skirts, naturally, requiring but a small volume of air, while those which are large and loose may require much more.

This new field of compressed air employment, in connection with the movie industry suggests vast possibilities of development in the not distant future.

VACUUM CONVEYANCE OF FINE DUST*

BY T. C. CLOUD.

In a case where the opportunity was afforded the author of making an entirely new departure in the moving of this class of material, [fine and often poisonous dust] the furnaces were producing a gas highly charged with arsenious oxide. This was, to a large extent, deposited in a complicated system of condensing chambers and flues, followed by filtration through bags in a bag house. The points at which it was necessary to remove the arsenious oxide from the bag house, flues, etc., were numerous, and it was also necessary to deliver all the material to the packing room, where it could be packed in casks for marketing. After considering the existing methods for removal and transport of this material, none of which appeared suitable, experiments were made with a powerful vacuum-producing plant, such as has lately been placed on the market and was originally used for the removal of dust from carpets and household furniture. This class of plant has lately been successfully adapted to the cleaning of boiler flues, and it appeared to the writer that such plant, with certain modifications, might be made suitable for the purpose in view. After some preliminary trials with a small plant, and also with one of double size, an installation was designed and erected of which the following is a description.

The vacuum pump, at normal speed (160 revolutions per minute), has a displacement of 20,000 cubic feet per hour and will produce a vacuum of 18 inches of mercury if all valves to the various branch mains are closed. In the packing house, the pipe main enters a cyclone separator in which the bulk of the arsenious oxide is deposited. Following this is another smaller separator. Finally the air is drawn through a shallow layer of water and then passes to the vacuum pump. The cyclone separator has a small storage capacity and the arsenical soot is automatically removed from this apparatus and discharged into the casks placed below. The smaller separator is furnished with baffle plates and collecting receptacle from which the deposit is only discharged at long intervals when the vacuum is off. The water separator is arranged so that a small continuous supply of water can be passed through it, or it may be charged and discharged intermittently.

The mains about the works are of ordinary gas pipe, which need only be screwed together in the ordinary way. All bends and entering branches are of large radius and, for moving the material npward, all vertical members are avoided and inclined pipes substituted. At numerous points about the works capped branches are arranged, to which, on removal of the cap, suitable flexible hose can be attached; either flexible metallic hose or reinforced rubber hose answers well. A suitable nozzle is fixed at the end of the hose, and on inserting this into the accumulated deposit, the latter is immediately sucked up and conveyed to the separating plant. This plant, having an air pump capacity of 20,000 cubic feet per hour, deals with one and a half to two tons of collected arsenious oxide per hour, and the farthest point from which a branch is situated is about 200 yards from the separator. The pump, in this instance, is electrically driven, and absorbs at the rate of 12 to 14 horse-power. The ease with which collecting hoppers, condensing chambers, flues, etc., are cleared out is remarkable. The men work entirely from the outside, the nozzle end of the flexible tube being pushed into the material, which disappears in a surprisingly rapid manner, and, of course, without the production of the slightest amount of dust. All the annoyance to the men caused by the handling of this material is removed, and respirators are superfluous.

It is easy to see how such a plant may be

*Journal of Society of Chemical Industry.

adapted for the removal and transport of such materials, and many others will probably occur. The writer is convinced, after seeing what can be done in the case of a plant in operation, that a similar plant can be made to work successfully over greater distances and on larger quantities, and there appears no reason to doubt that the system can be satisfactorily applied to deal with any quantity of suitably fine material.

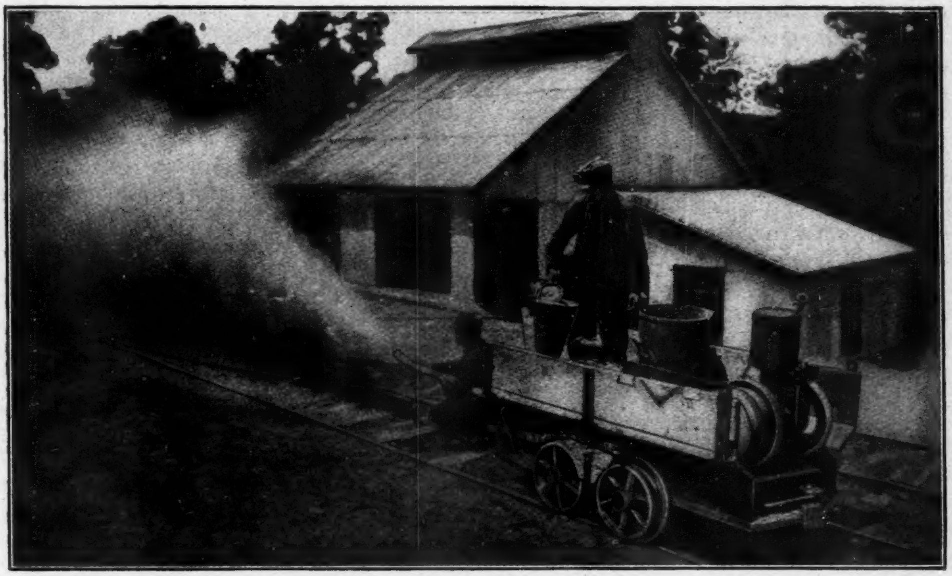


FIG. I.

ROCK DUSTING TO PREVENT COAL MINE EXPLOSIONS

At the experimental mine of the Federal Bureau of Mines, Experiment, Pa., a large number of explosion tests have been made, under various prepared combinations of conditions, for the purpose of determining the efficiency of rock dust both in preventing mine explosions and in checking their extensive propagation. As a result of the experiments the rock dusting method seemed to have pronounced advantages over the use of water and arrangements were made with a Pittsburgh district company to rock-dust a portion of one of its mines, keeping careful record of costs and other particulars, with constant inspection by Bureau Engineers.

This work was continued for a year, with results so satisfactory that the dusting has been extended to three other mines, and officials of various companies are investigating the system, and the probable wide adoption of the method calls for the development of special machinery to supply the demand.

Rock dusting has been carried on in the Delagua mine of the Victor-American Fuel Company, in Colorado, for more than four years. The first rock dust that was used in the Pittsburgh district was pulverized limestone 75 per cent. of which would pass through a 100-mesh sieve. It was found that material prepared by grinding in a hammer crusher equipped with a 1-16 in. slotted screen was only a little less efficient than the pulverized dust.

In rock-dusting a mine entry, the best way to apply the first coating is, under most conditions, to throw the dust on by hand, because a thicker and better-distributed coat is thus obtained. In time, coal dust settles on the rock dust, and redusting is desirable. This is best done by a rock-dusting machine, which blows into the air current a cloud of rock dust that settles in a mantle over the coal dust. The use of a machine decreases the cost and greatly increases the convenience of redusting. The photo Fig. 1 shows a machine as used at the experimental mine.

The Director of the Bureau of Mines is addressing crusher and blower manufacturers as follows:

TO MANUFACTURERS OF CRUSHER APPARATUS.

As the result of mine-explosion experiments at the experimental mine and explosion-prevention investigations in the field, the bureau is strongly recommending the use of finely crushed or pulverized rock dust, having no or a very small percentage of combustible matter, as a preventive for coal-mine explosions.

Nearly all mine explosions in bituminous coal mines, once initiated, are extended by the fine coal dust that is found on the surface of most mine entries. This dust, when blown into a cloud, is explosive. If rock dust is thrown on the surfaces it covers the coal dust or becomes mixed with it, and if a sufficient amount is used, the cloud of dust blown from such surfaces in the event of an explosion is nonexplosive and quenches the flame. The more finely divided the dust is, the better it is for rock-dusting. Tests have indicated, however, that a dust all of which will pass through a 1-16-in. slotted screen and having about 40 per cent. through a 100-mesh and 25 to 30 per cent. through a 200-mesh screen is satisfactory for the purpose. Further detailed information concerning the use of rock dust in mines can be obtained from Bureau of Mines Technical Paper 84.

The bureau desires to inform you of this new field for crushing or pulverizing machinery. Information as to whether your company now has machines which will furnish material as fine or finer than that given, the output per hour, horse-power required and cost will be appreciated.

TO BLOWER MANUFACTURERS.

It is desired to call your attention to the demand, which has arisen in connection with the work of prevention of coal-dust explosions in mines, for a machine designed to blow a cloud of rock dust. This will probably be of interest to you, as a positive blower is one of the essential parts of the apparatus.

One of the methods now strongly recommended by the Bureau of Mines for the prevention of coal-dust explosions is to coat the mine-entry surfaces with rock dust so that in the event of an explosion a thick rock-dust cloud will be formed and quench the flame. The first coating of rock dust is thrown on the mine-entry surfaces by hand. After a time some coal dust settles on the rock dust, and it becomes desirable to apply another coating of rock dust. This is probably most conveniently done by the use of the rock-dusting machine. It blows a thick cloud of dust into the air current, which carries it for long distances, the dust gradually settling out and forming a mantle over the coal-dust deposits.

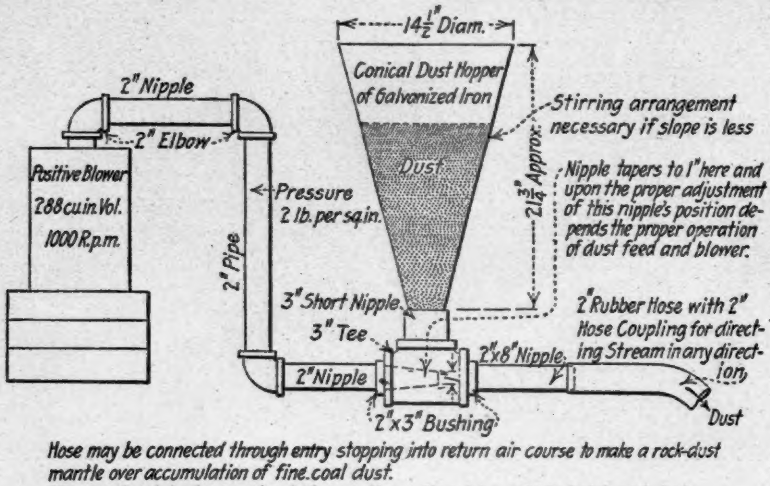


FIG. 2.

The apparatus, as used at the experimental mine of the Bureau of Mines, consists of a small positive blower, the air from which passes through a 2-in. pipe to the injector

chamber into which the rock dust is fed from a hopper; the air and dust, becoming mixed in this chamber, is blown through a hose into the atmosphere.

Fig. 2 shows an outline arrangement of the apparatus. The blower used has a volume of about 288 cu.in. and is run at about 1,000 r.p.m. The pressure in the outlet pipe when the machine is operating is about 2 lb. per sq.in.

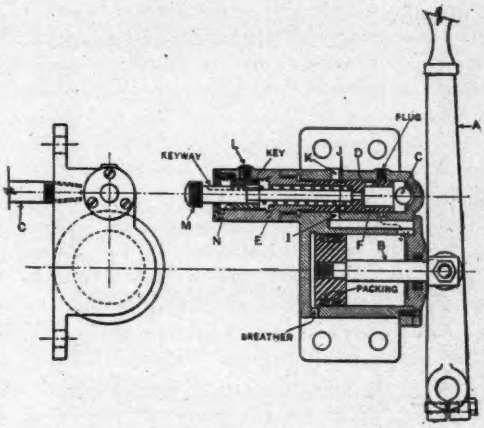
The injector chamber should be carefully constructed. The 2-in. air inlet is reduced to a nozzle of 1-in. opening, and the nozzle should extend far enough into the chamber of the 3-in. tee so that the nozzle opening is below the outer edge of the dust-hopper opening. The dust then falls or is drawn forward into the air stream and is blown through the hose. A flexible hose is desirable for an outlet so that the air stream can be pointed in any direction; also this permits its connection to pipes through stoppings to direct the dust stream into aircourses or entries having no track and which ordinarily receive no treatment to render the coal dust present inert.

As the rock-dusting method of rendering coal dust inert is now being taken up actively, it is believed that there will be a considerable demand for such apparatus. Information as to whether your company could furnish such equipment and the approximate cost of the same would be appreciated.

SAFETY VALVE FOR FALL OF PRESSURE

The automatic air valve here described was designed to prevent accidents on machines equipped with compressed air chucks. Simultaneous demand from a number of air tools or the breaking of an air line is likely to result in a sudden decrease of pressure, and this may cause the work to be released from the chuck. It is to overcome trouble of this kind that the safety valve was designed.

Referring to the illustration, it will be seen that the lever *A* which is used to start or stop the machine is connected to piston rod *B*, but this does not interfere with the normal operation of the lever. Air pipe *C* is a branch from the main supply pipe of the air chuck, and furnishes pressure to operate hardened steel valve *D* which is held back by spring *E* as long as the air pressure in the line remains normal. If the pressure decreases to



SAFETY VALVE FOR FALL OF PRESSURE.

a point below the minimum required to operate the chuck, spring *E* throws valve *D* back and admits air to the cylinder through openings *F*, *G* and *H*. Any leakage of air past the valve will not accumulate in the cylinder and cause a shut-down of the machine because it escapes through the by-pass and openings *I*, *J* and *K*.

The tension of spring *E* may be adjusted by loosening a set-screw *L* and revolving knurled rod *M* that is riveted to valve *D*, thus operating screw bushing *N*. As rod *M* moves with valve *D* the position of the valve can be easily estimated; and this is important because if the air pressure is low, it is impossible to start the machine without exerting sufficient force to overcome the total pressure against the piston. This device shuts down the machine if the air pressure falls below the minimum required to hold the work in the chuck; it is sensitive to a varitation in pressure of five pounds per square inch and adjustable for any reasonable range.—LAWRENCE FAY, *Machinery*.

PNEUMATIC MASSAGE

A very effective as well as simple device for obtaining massage of limbs which have been rendered inactive by the ankylosis due to a long inaction in case of maladies, is brought out by Dr. Bergonie, a well-known French scientist. The wounded are subject to this drawback, owing to adherent scars which come from wounds, or by long repose due to treatment of fractures, in which cases the limbs become deadened from lack of movement. He

treats the member by a mechanical massage upon the pneumatic principle, by using a large box one of whose sides is made up of an elastic membrane (Marey device). The limb is held in such a way that the membrane comes in contact with it, then when an air pressure is exerted on the box, by the air pump, the membrane swells out and presses on the patient's arm. If the pressure is supplied in the form of pulsations of air, a veritable massage is obtained in this way, and it is very exact, for the pressure can be regulated from high to low by a simple adjustment, through all degrees. Again, the frequency of the pulsation can be regulated within a good range, and can reach 120 pulsations per minute. The present method has a great advantage of needing only a very simple apparatus, and at the same time is powerful and effective.—*Scientific American.*

DRILL-STEEL SHARPENING AT OLD DOMINION MINE

The following notes, reproduced with slight changes, from *Mining Press.* San Francisco, were compiled by I. H. Barkdoll, mine superintendent of the Old Dominion Mining and Smelting Company, Globe, Arizona.

The drill steel used by this company is of four kinds: Leyner steel; piston-drill steel, stoper steel; and Jackhamer steel. Leyner steel is made from 1¼ in. round, hollow keystone bars. It is cut into four lengths: 2 ft. 9 in.; 4 ft. 9 in.; 6 ft. 9 in. and 8 ft. 9 in. Shanks and bits are made on No. 5 Leyner drill sharpener. When sharpening, the gaging is done automatically, only one heat being taken for each shank or bit. The different gages on the Leyner steel are 2½ in., 2¼ in., 2 in., and 1¾ in. Four-point cross-bits are used, with shoulders ⅝-in. thick and cutting edge drawn to 90% pitch. Stoper steel is made from inch grooved Keystone steel cut into lengths of 2, 3, 4, 5, and 6 ft., with bits gaged 1¾, 1⅝, 1½, 1⅜, and 1¼ inch. Jackhamer steel is made from ⅞-in. hexagon hollow Keystone, cut into lengths 2, 3, 4, 5, and 6 ft. and gaged the same as the stoper steel; both the four and six-point bits are used, depending on the ground to be drilled.

Sharpening and tempering of all the steel is by the same process. Hollow steel before heating is thoroughly cleaned and blown out by means of a steel tube attached to a spring-valve on the compressed-air line. A single heat is taken for the punching and sharpening operation, the bits being heated for 2½ in. in a quick fire. After heating, the hollow steel is punched in the centre by an air-punch (made from a No. 2 Leyner drill sharpener fitted with an air-cylinder punch), enlarging the hole sufficiently so that, when sharpened, it will not close. It then goes to the sharpener, where it is sharpened and gaged at one operation. Stoper and piston-drill steel are treated in the same manner except that a shorter heat is taken, as no punching is required, this being all solid steel.

Piston-drill steel is made in the following manner. Starters are cut from 1¾-in. Keystone grooved steel 2 ft. 4 in. long, with shanks drawn on one end to fit the drill-chuck. The 2nds, 3rds, 4ths, and 5ths are made by welding 1¾, 1½, and 1¼-in. grooved steel, cut 2 ft. 4 in., on 1¼ hexagon steel, making the total lengths 4, 6, 8, and 10 ft. The gages for this steel are 2⅝, 2⅜, 2⅛, 1⅞, and 1¾ in. These are also cross-bits, ⅝ in. thick at the shoulder, with the cutting edge drawn to 92% pitch. This steel is standard for all our types of piston-drills such as Sullivan, Wood, Holman, and Ingersoll-Rand 3-in. machines, and does not prove too heavy for 2¾-in. and 2⅝-in. machines. This standardization of piston-drill steel is made possible by having the chuck-bushings in all machines standard, and allowing only one class of steel for each class of drill.

All tempering is done by re-heating, which hardens where hardness is required, while the remainder of the drill remains soft and tough. In tempering with the same heat after sharpening, the drill is often hardened too far back, and the bit is liable to break in hard ground. The tempering heat is as short as possible, with an even slow fire to a cherry red, then dipped in pure water. The water is kept at an even temperature by having the intake-pipe at the bottom and the overflow on top, with the water in continuous circulation. In tempering shanks we heat about an inch of shank, dip, and draw to a light-straw color. Much depends, of course, on the class of steel used. Breakage on our steel averages ½% of the pieces used, or 3 in 600.

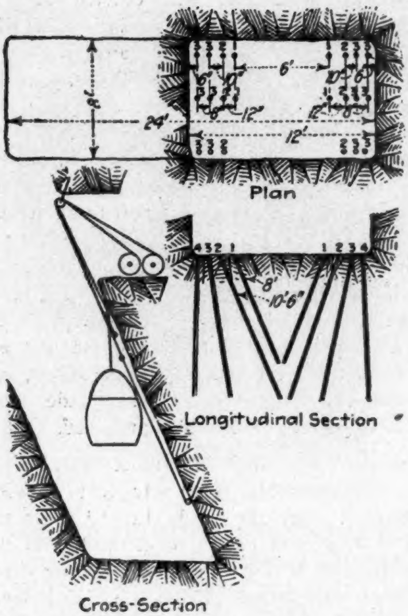


FIG. 1. DRILL ROUND USED IN SINKING CREAN HILL SHAFT

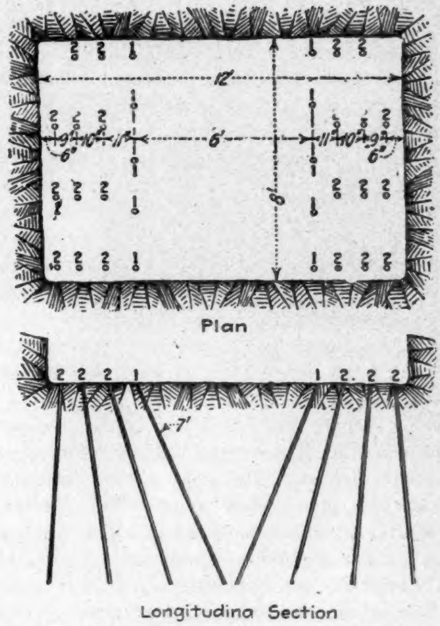


FIG. 2. DRILL ROUND EMPLOYED IN SINKING DOMES INCLINE

THREE SHAFT SINKING METHODS

The following, by Albert E. Hall, which we reproduce from Engineering and Mining Journal, will be found interesting. It tells its story very clearly and without waste of words, though suggesting that a little might have been said about the drills employed and their manipulation.

The first method was used at the Crean Hill mine, Ontario, Canada. This shaft was inclined at 68°, and while 24x8 ft., the work was done in halves, each 12x8 ft. Two bars were employed with only one machine in each bar. To give a break in the first half 22 holes were needed. A double cut was used, but only four holes were drilled in the first cut, while six were needed in the outside cut. Six holes on each side, numbered 3 on Fig. 1, made up the rest of the round. The four first cut holes marked 1 were first fired. The second set of six cut holes, marked 2, were fired next; when the shaft had been mucked out, the rest of the round was fired. The cuts usually pulled about 7 or 8 ft., using about 450 to 500 sticks of gelignite to the round. The holes were fired by battery. The shaft was sunk in schist, and the cost was from $22 to $25 per ft. for one half.

Mucking was done into a bucket pulled to the level above by an air hoist placed on the level. The end shaft compartment was used by the bucket while the skip was brought down below the bucket in the next compartment and the bucket dumped into it. The hoist had two drums, the first of which carried the hoisting cable, while the second carried a cable for the bucket trolley to run on. A hole was always drilled near the shaft bottom, in which an eyebolt was placed to which was tied one end of the running cable. When the first half of the shaft had been entirely completed, work was started on the second half, which was stoped down into the first half. Anywhere from 9 to 12 holes were used on the second half and the cost was only about $12 per ft. No time was lost in mucking on the second half. As soon as drilling was finished, the holes were blasted, and after a very small amount of cleaning and scaling the machines could be set up again and mucking started on the bottom of the first half.

In contrast to this method of using the

bucket was that used in a shaft inclined at 47°, which was sunk by the same company at another mine. Here small air hoists were also used to hoist the buckets, which ran on skids, two buckets being used, each having its own hoist and using the two end compartments of the shaft. The hoist-cable pulley, as well as the dump, was on the foot wall of the shaft instead of on the hanging wall as in the previous case. The bucket was automatically dumped over a pocket in the foot wall, and the muck was drawn off from this pocket via chutes, in a drift run behind the shaft, and thence trammed to the rock pocket on the level, from which it was hoisted by the skip with the other mine rock.

The second method is for a flat inclined shaft at the Dome mine, South Porcupine, Ontario, Canada. The slope of this shaft was about 10°, and it was raised. The size was 12x8 ft. In each round 32 holes were drilled. There were five holes, numbered 1 in Fig. 2, on each side of the cut, while four were sufficient for the rest of the round except for the square-up holes, where it was found that three would do the work. Two machines were used on a bar. About 5 to 6 ft. was pulled in a round, and about 25 ft. advance a week was considered fair. The cut was fired first. As soon as the smoke and gas had cleared, the rest of the round was fired. After the incline had advanced a little, the gas was found to cause considerable delay even with the air blowing as is the custom. A water spray was then tried, setting up the pipe before the blast and afterward turning on the water from a valve placed outside the incline. After the spray had run a few moments, the men entered and pulled it to the face, spraying the face, wall, muck and the sides. While before the use of the water it had been necessary to wait probably an hour before work could be started, after its use the men could return almost immediately. The machinemen did no mucking. A small air hoist was placed at the bottom of the incline, and an extra bar was set a short distance behind the machine bar to which extra bar was attached the pulley by which the cars were pulled up for the trammers to load.

The third method was used at a new shaft being sunk at the Creghton mine, Ontario, Canada. All mucking in this shaft was done by the machinemen directly into skips. A good temporary headframe was erected and an electrically driven two-drum hoist installed that was as good as the permanent hoists at some mines. This shaft was 38x8 ft. and inclined at 55°. The same type of cut as that used at Crean Hill was employed, but the shaft was sunk all in one part. Blasting was done electrically, the cut was fired first and mucked out, after which the rest of the round was fired. Three bars were used on each side of the shaft, carrying two machines each, making 12 machines in the shaft. The rounds pulled ranged all the way from 6 to 10 ft., but averaged about 7 ft. Complete and accurate figures were kept of all operations, and an elaborate daily report was made from which a monthly sheet was prepared.

The shaft was sunk in granite most of the way. Considerable time was lost blowing smoke, but when the shaft reached the sixth level, a drift was put in to connect with the old workings, which furnished a strong draft and good ventilation. From the eighth level a drift was driven to the line of the shaft and a raise put up to meet the shaft above. Chutes were constructed at the raise bottom with the idea that muck could be drawn off here after the raise met the shaft and that the machinemen could employ all their time drilling facilitated by stoping the shaft into the raise. The raise proved to be rather small, however, and the muck could not be drawn off quickly enough, so that considerable mucking had to be done. The raise choked up once or twice and had to be blasted down. On the whole it can perhaps be said that the raise hardly justified itself. True, a few additional feet were gained in advance for the month, but since the rock drawn off from the chutes below had to be taken up through the ore shaft and the ore hoisting suspended from time to time, the output was lowered. No figures are available, as to the cost of raise and shaft. It took about 8 to 10 hr. to drill a complete round and about 24 hr. to muck it out and blast.

The Gas Pressure in a tungsten glow lamp when the lamp is cold is about one-half or two-thirds of an atmosphere. Even when hot there is no great excess of pressure, and therefore no fear of an explosion.

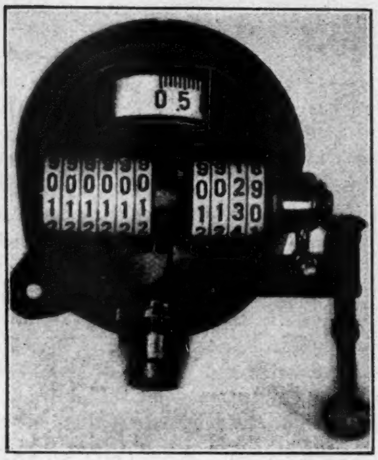


FIG. 1.

FIG. 2.

AN AIR FRICTION SPEEDOMETER

The half-tones here reproduced from The Scientific American show a run speedometer for automobiles which employs neither the centrifugal nor the magnetic principle, but relies upon the friction of air for its indications. This speedometer has been developed by a leading watch company to a commercial style after three years of experimenting.

The two main components of the speedometer in question are a driving cup, which is rotated by power from one of the automobile wheels through the flexible shafting, and, suspended over and around it, a driven cup. The driven cup, which is also the indicating one, since the numerals representing the miles per hour attained are marked on its periphery, is inverted over and around the driving cup.

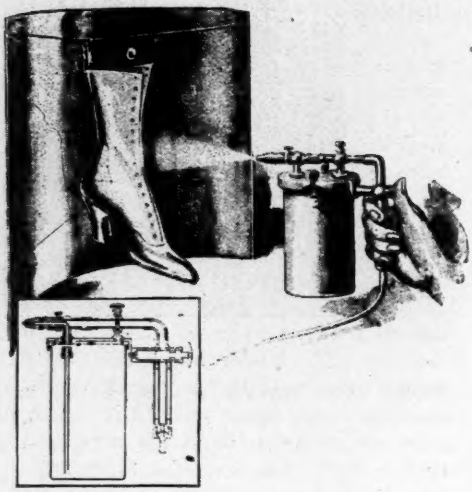
The driving cup of the speedometer comprises two concentric brass cups with a spacing of .108 centimeters between the two vertical walls, called "ribs" for convenience, both of which are rigidly mounted on a vertical shaft so as to revolve in perfect unison. Likewise the driven or indicating cup is made up of two aluminum cups attached together so as to form a single cup insofar as its mechanical operation is concerned. These cups are extremely light, being made of aluminum .008 centimeter thick. This means that 313 of these cup thicknesses would be required to total a thickness of 1 inch.

The driven cup when in position in the instrument has its inner rib floating in the annular space between the ribs of the brass cup, while the outer rib of the aluminum floats outside of the brass cup. There is an air space of .5 millimeter between the ribs of the brass and aluminum cups.

The operation of the new speedometer is of the utmost simplicity: the revolving of the brass cup generates the air friction which, were it not for a regulating hair-spring serving normally to maintain the aluminum cup at the zero marking, would cause the latter to revolve; in other words, the air friction developed serves as a means of transferring the driving power from the brass cup to the aluminum cup. The hairspring is so adjusted as to permit the aluminum cup to be affected by the air friction in direct proportion to the speed of the brass cup, so that the reading of the instrument will be correct.

The air friction developed in the instrument has been proved to be directly proportional to the speed of the revolving cup. It is this fact that has made possible a uniform calibration without introducing compensating devices to gain this end. Comprehensive laboratory tests are reported to have proved that air friction is not influenced by heat, cold or altitude up to 10,000 ft. The revolving cups, contrary to expectations, do not have to be carried in an airtight compartment, and no sealing is necessary. The regulation between the tension of the hairspring and the tendency of the aluminum cup to rotate under the influence of the air friction is so

delicate that the instrument indicates immediately all speed changes, and indicates as low as one half mile per hour. Yet the instrument is so sturdy that its accuracy is not affected by vibration in regular service.



COMPRESSED AIR SAVES UNSALEABLE SHOES

When one of the large manufacturing companies found some time ago that it was oversupplied with shoes having light-colored cloth tops, it was decided that the entire stock should be dyed black. In order to accomplish this without ruining the internal appearance of the shoes, a special dye was made and applied by means of compressed air instead of a brush. The device is similar to some of those employed in spraying paint, and practically the same in general principle as an atomizer. The shoes were suspended from a line stretched in front of a screen while being worked upon. The work was done quickly, neatly, and without injuring the linings.

COPPER TO PRODUCE HIGH VACUUM

Finely-divided copper, which may be obtained by reducing a solution of a copper salt and is sold commercially as "precipitated copper," absorbs gases with great readiness, the vapor pressure of the gases thus absorbed being so small that under suitable conditions it may be used for the production of high vacua. A bulb containing a few grammes of the copper is sealed to the vessel to be exhausted, the vessel being then partially exhausted by means of an air-pump and the copper heated to about 250° cent. (482° F.) When the air pump is disconnected and the copper allowed to cool, the residual gases are rapidly absorbed. This absorption is not due to chemical combination, since the gases are liberated when the copper is heated. Great care is necessary when the copper is being used for the first time, as the occluded gases may sometimes be evolved with such violence that the copper is blown through into the pump; consequently not more than one-third of the bulb should be filled with copper; and a short length of the tube connecting the bulb and the pump should be tightly packed with glass wool.

JACKHAMERS AT THE POZO MINE

BY EMMET F. GALLIGAN.*

The writer has recently had the unusual experience of encountering a sulphide ore so extremely hard that it could not profitably be mined with stoping machines. It was nearly impossible to drill holes deeper than 3 ft., as the drill bits would heat to such an extent in a short time that they would batter and it would be impossible to get another steel to follow.

After experimenting for several weeks with different kinds of steel, it was decided to discontinue back-stoping and try mining underhand with jackhamers. It was an easy matter to handle the muck, as there was a ventilating raise through the block at the end of the ore shoot; so two jackhamers were started benching, taking the cuts from the raise. At first not much headway was made, as the benches had to be started in such shape that the ore would run into the raise without any great amount of mucking. As previously found in work with the buzzers, the drill bits of the jackhamers would heat in the dry holes and there was no available water closer than the second level below. Therefore a pipe line was laid to the water supply and a 500-gal. tank installed with air connections, so that the water could be forced through the pipe to the machines. Each jackhamer was then equipped with a water hose, clamping it to the machine just above the steel holder,

*Superintendent Pozo Gilpin Co., Idaho Springs, Colo.

and on the end of this hose a nozzle valve was used so that the machineman could regulate the water to clear the hole but not use an excess. At this point the grief was ended, as the water cooled the drill bits and it was found possible to drill holes to any desired depth. The tonnage broken per jackhamer was greater than it had been possible to break with three buzzers in the backstope.—*Engineering and Mining Journal.*

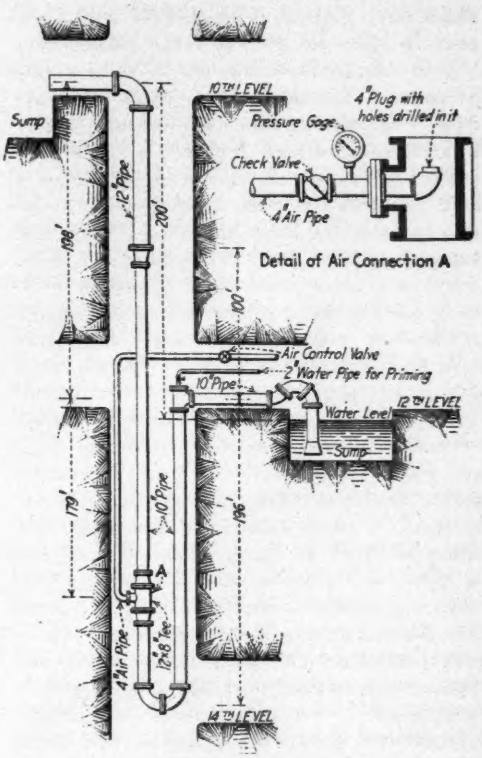
AIR LIFTS AT OLD DOMINION MINE

BY P. G. BECKETT.*

An air lift was installed from the 12th to the 10th level and later one from the 10th to the drain tunnel. The submergence on the air lift from the 12th to the 10th level was 177 ft., of 47%. The top 100 ft. of the column was made of 12-in. pipe; the bottom 100 ft. and the two legs were of 10-in. pipe. The air was supplied from a 4-in. line at 80 to 90 gage pressure.

Short tests on this air lift showed that it handled to the 10th station over 1,650 gal. per min., with an air consumption of 1,080 cu.ft. per thousand gallons. The highest efficiency obtained was 36%. In the lift from the 10th up to the drain tunnel, which was 431 ft., the submergence was 188 ft., or 30.4%. The top 200 ft. of the column was 12-in. pipe, while the bottom 231 ft. and the two legs were of 10-in. pipe. The air was supplied through a 4-in. pipe at a gage pressure averaging from 90 to 100 lb., but which was always kept as high as possible. This lift delivered to the tunnel 1,233 gal. of water per minute, with an air consumption of 2,681 cu.ft. per thousand gallons delivered. The maximum efficiency showed practically 30%.

During the period of unwatering the 16th level, the two columns on the 18th level Aldrich pumps were converted into air lifts, one delivering to the 14th level and the other one to the 12th. The water at that time stood 36 ft. above the 16th level. These lifts were made up as follows: A 3-in. air line provided with a foot-piece made from 3-in. steel tubing, plugged at the bottom and perforated with $^3/_{16}$-in. holes drilled at a 45° angle, was lowered to the sweeps connecting the columns with the pumps. Both lifts pulled the water through the valves and suction of the Aldrich pumps and delivered to the 14th level about 1,300 gal. per min. and to the 12th about 1,000 gal. per min. The accompanying sketch gives the arrangement of the piping used on the 200-ft. air lift.



AIR LIFT AT OLD DOMINION MINE.

*From advance copy of a paper: "The Water Problem at the Old Dominion Mine," for the Arizona meeting of the A. T. M. E., Sept., 1916.

QUARRYING AT THE EDGE OF THE OCEAN BED

There is one fact that has made the production of Canadian grindstones among the most interesting of all quarrying operations in the world. The ledges of stone that are utilized are on the coast line and extend out into the ocean. Much of the stone is actually extracted beneath the sea level. One of the most important centers of the industry is at Stonehaven, Gloucester county, New Brunswick. Here are located the quarries of the

Read Stone Company, which have been operated for sixty years. The areas worked have been reclaimed from the sea by the building of dams. This has been no small undertaking. The dam around the present quarry which has just been finished, is over one-quarter of a mile long, and in all about a mile of dams has been built here. Anyone who has seen the Bay Chaleur in a storm will know that these dams are no flimsy affairs. They have been built chiefly of timber cribwork filled with stone and heavily rip-rapped on the side exposed to the sea. The dams have been made water tight by the use of a clay puddle pounded tight.

After the dam is built the water is pumped out and quarrying operations start. The stone lies in horizontal sheets of varying thicknesses, the total depth of rock being about 25 feet. A steam channeller, steam and air drills are used as required, and by the use of these and with powder and wedges the rock is quarried to the required size. It is then hoisted to the "dump" where the stonecutters take it and shape it round. From there, if it is not too thick for a single grindstone, it goes direct to the lathe to be finished. If the block is say two or three feet thick it is sent to the saws and cut to the required thickness. This applies to the larger stones, say 48 inches in diameter and larger. The smaller stones are split out of the irregular shaped pieces that come out along with the larger stones. The stones are cut round and shaped as a rough grindstone. In the olden days the grindstones were finished by hand by means of chisel and mallet. Now the rough grindstone is taken to the mill where the eye is drilled and the stone turned on a lathe in a very short time. Indeed an expert turner will finish a small stone in five minutes.

DANGER IN COPPER CARBIDE LAMPS

In Miners' Circular No. 18, of the United States Bureau of Mines, on "Notes on Miners' Carbide Lamps," there is the suggested rule, "Never use carbide in a lamp made of copper; the lamp may explode." It seems that there was an instance wherein a carbide lamp made of copper exploded, presumably due to the presence of copper acetylide. The circumstances, as related, were that the lamp was placed on an anvil and struck with a hammer, resulting in an explosion. The precaution referred to was suggested because, under similar conditions, a carbide lamp made of copper might be made to explode following a fall of rock, particularly if the lamp was resting on the floor of the mine. The chemistry of the case is being investigated.

TELESCOPE TELLS OF AIR CURRENTS

The following is by Prof. W. H. Pickering, in charge of the Harvard Observatory at Mandeville, Jamaica:

If we point a telescope on a bright star, remove the eyepiece, and place the eye near the focus, we perceive a bright disk crossed by dark fluctuating dots or lines. These are due to currents in our upper atmosphere. The same result is obtained if, instead of removing the eyepiece, we draw it out a few millimeters beyond the focus. In the latter case, if we determine the number of millimeters we can readily compute the altitude of the current whose motion we are observing. The dark lines travel longitudinally in the direction followed by the current. At Mandeville the "seeing" is never very bad, except when a hurricane is in the neighborhood. At such times the mode of observation above described gives timely notice of the approach of a hurricane, and also furnishes a means of studying the movements of the upper currents in connection with these disturbances.

THE CHEAPEST BLOWER

There are over 800 miles of underground water piping in the Rand mines and over 150,000,000 gallons of water are used every month underground. Fans, having a capacity of 4,500,000 cubic ft. of air per minute, have been installed.

Let us see about this fan capacity. An acre is 208 ft, square. Say that a storm wind is blowing at 50 miles per hour and that the vertical depth of the air current is one mile. Then, if we figure correctly, the volume of air traveling across the acre per minute will be more than 1,000 times (1,073) the above volume delivered by all the fans of the Rand. This might set us to thinking a little about the horse power required, merely to keep up the air circulation of the earth, but we generally are content to assume that the wind just blows itself.

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EVERYTHING PNEUMATIC

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CONTENTS

PREPAREDNESS FOR PEACE OR WAR

Although we are settling into the habit of talking as little as possible about the world-war which rages still unchecked, it yet subconsciously dominates all our thoughts, and especially that which strives to pierce the future, for we have not ceased to believe that before long absolute, and we may hope permanent, peace will prevail.

The war was not only in itself a surprise to the world, being something, at least in the overwhelming magnitude and horror of it, which all had deemed evermore impossible, but it has also surprised the world in the novelty of the unusual methods employed and in their unparalleled potency.

Two novel devices first successfully employed in this Twentieth Century have revolutionized the war habits which all the previous ages had laboriously developed. The submarine and the aeroplane, not forgetting the zeppelin, have fundamentally transformed the strategy of both attack and defense.

The submarine and the zeppelin we can scarcely think of as ever to be usefully employed for any peaceful purpose. Their sole ability seems to be in the line of destruction, the one by hurling torpedoes and the other by dropping bombs with boundless uncertainty of aim. It is to be noted that both of these are exposed to unusual risks, and that the probability of short careers attends them, with short life for their crews.

With the aeroplane in war the case is very different. It is not essentially a craft of much account in actual offensive operations. It cannot carry great weights of explosives, and in no case can it drop them with any precision. This is not in any way to belittle the services of the aeroplanes in the strategic movements of the war. It may easily be believed that their aggregate services have counted for much more to both contestants than have those of the submarines and the zeppelins. The older and, as we may say, standard systems of picketing and reconnoisance have been superseded by the larger scope of vision and the accurate mapping of the field from overhead, so that all the larger movements of the foes are known as they occur, and surprises are impossible.

The surprises of the present war suggest some need of caution in anticipating and preparing for the possible demands ahead of us.

The future of the submarine and also of the zeppelin for large and constant employment in war may be doubtful. Even our greatest warships are constantly superseding each other, so that in a decade they are successively rendered absolete, and apparently the most staying qualities are after all in the aeroplane whose most insistent characteristic is instability. The aeroplane is unique in that it is equally ready for all peaceful employment and without change it is also fully equipped for most effective war service.

We may reasonably expect in the natural course of events that future developments of this infant prodigy of invention may reveal possibilities as yet little thought of and lead to its employment in vast numbers, not only for rapid transit in all directions but also for purposes of pleasure and diversion, all of which must mean also constant readiness for emergent duty. As the costs of warlike equipment go the aeroplane has the merit also of comparative cheapness in construction, operation and maintenance, and it would seem that a mild appropriation in its interest must be a wise investment for the government. But, whether or no, all who are perfecting and multiplying the aeroplane are working for preparedness.

DEATH OF PROFESSOR SWEET

Professor John E. Sweet died suddenly at his home in Syracuse, N. Y., May 8, in his 84th year. He was educated in the public schools and when 18 he was apprenticed to a carpenter, the next year he was in an architect's office and developed skill as a draftsman. He was associated with various concerns in this capacity, for a couple of years of the time in England. He devised a typesetting machine which was exhibited at the Paris Exhibition of 1867. Then he was for a time a bridge builder and also built the first "straight-line" engine.

All of this is to be regarded as preliminary to his life career, which may be said to have begun when in 1873 he became professor of mechanical engineering in Sibly College of Cornell University. After six years at Cornell he took up the commercial development of his straight line engine at Syracuse, which has been his principal occupation ever since.

To his latest day he never ceased to be the professor, the instructor, to the mechanics and engineers of the world. He was perhaps the best known and certainly the best loved engineer in America. He was untiringly kind and helpful and suggestive. He was a frequent writer for the technical press and led in the transformation of shop and mechanical engineering practice of the last fifty years. He was a leader in the founding of the American Society of Mechanical Engineers, was one of its earlier presidents and was made an honorary member in 1904. He had been president of the Engine Builders' Association of the United States. He had served as mechanical expert for the U. S. Navy Department and in 1893 was one of the jurors of the Chicago Exposition. Syracuse conferred on him the honorary degree of Doctor of Engineering.

WORLD'S LARGEST OIL WELL

Under a pressure of 1,035 lb. per square inch and flowing at a rate of 260,000 bbl. a day, a well, known as Cerro Azul No. 4, near Tampico, Mexico, and said to be the greatest oil well in the world, was recently brought in by the Mexican Petroleum Company, Ltd. The well casing had been tested to a pressure of 1,050 lb., which was practically equaled by the pressure registered after the well was closed. The force of the escaping gas under this pressure blew the 2-ton drill bit out with it and threw it 125 ft. from the well. Its cable became entangled with the valve at the top of the casing and tore the latter off. The drill bit and the escaping oil, which subsequently rose to a measured height of 600 ft., demolished the derrick. It is estimated that 1,000,000 bbl. escaped before the flow was shut off by sliding an extra valve over the casing in a tongue-and groove track clamped to the head of the well. More than half of this oil was saved in temporary reservoirs, and the rest of it was burned after it had run some distance from the well and before it left the company's property.

Air drill hose is often affected unfavorably by miners pouring oil in the hose itself before connecting to the drill machines. This saves them the labor of unscrewing the oil plugs and replacing them. The oil may be good for the drill but surely is bad for the hose.

LIQUID AIR EXPLOSIVES

Readers of Compressed Air Magazine have not found in its pages much encouragement to believe that liquid air has a large future as an explosive for mining and other purposes. We reproduced in a recent issue, and for just what it might be worth, an account from a German publication of the apparently successful use of liquid air as an explosive agent at Charlottenburg. The following, from *Mining Magazine,* London, puts the matter in a clearer light.

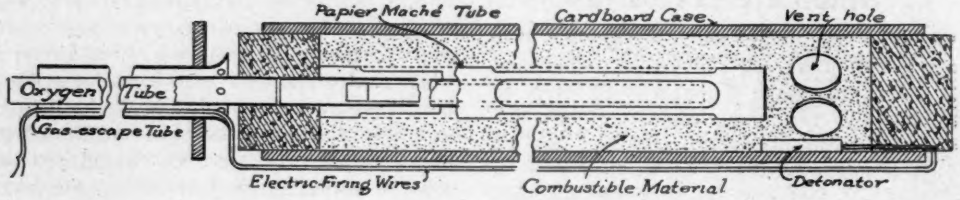
Paragraphs have appeared in German technical papers and in the press of neutral countries, which have subsequently been copied into English and Colonial papers, describing the application in Germany of liquid air as a substitute for ordinary mining explosives. Details are given relating to its application on the Rammelsberg mines, with particulars of the cost of manufacture and use. The cry is that this use of liquid air has partly obviated the necessity of relying on nitro explosives, and to that extent has nullified the British blockade which prevents the delivery of Chile nitrate to Germany.

A GERMAN RED HERRING.

We believe, however, that this is a typical German red herring devised to withdraw attention from the fact that nitric acid is now made chiefly from the air by methods published long before political bias could be suspected.

To avoid confusion in the minds of readers unacquainted with the subject, we may prefatorially state that, broadly speaking, modern explosives may be said to be made by treating various organic substances with nitric acid, the nitro body or nitrate thus formed being used with or without a mixture of various oxygen-carrying salts such as ammonium nitrate, and sodium and potassium nitrates. Formerly nitric acid was entirely and still is largely produced from a natural nitrate, such as is obtained in Chile, by the action of sulphuric acid. Of recent years, however, the acid has been made on a considerable scale by the fixation of atmospheric nitrogen, either directly by electric discharge through air, or indirectly through the production first of ammonia, and the subsequent conversion of the latter by means of platinum sponge as a catalytic agent. The use of liquid-air compositions as substitutes for nitro-explosives was first proposed about twenty years ago, when Linde succeeded in producing liquid air on a commercial scale. At first it was supposed that liquid air by itself, placed at the bottom of a hole, if properly confined and heated to the temperature of the rock, would provide sufficient energy to rend or disrupt the rock. But the time required to transport the liquid air from the place of manufacture to the place where it was used, and to charge the hole, was too great; and, moreover, it was expected that it would disrupt the rock by accumulated pressure due to absorption of heat rather than by detonation. Linde subsequently presented the idea in a new light when he suggested that liquid oxygen should be used in preference to liquid air, owing to the greater capacity of the former to support combustion, and thus, when mixed with suitable organic substances, to promote conditions favourable to a rapid combustion or even detonation. When air is liquidfied, its two chief components can readily be separated, and both oxygen and nitrogen can thus be obtained for various industrial purposes. One of the uses of nitrogen produced in this way is to convert calcium carbide into cyanamide, a substance that subsequently can be made to yield ammonia. Linde then evolved the explosive known as "Oxyliquit." He found that liquid oxygen, 90% pure, brought into contact with powdered charcoal or with petroleum absorbed in kieselguhr, produced a mixture capable of detonation; in fact, a very powerful explosive mixture was formed. But a great many difficulties were encountered in applying the discovery to practical blasting work, for the tendency of the liquid to assume the gaseous condition renders it almost impossible to load and fire the bore-holes before so much of the oxygen has escaped as to render the mixture practically non-explosive. Its industrial use therefore remained in abeyance for some years.

The method of applying this invention to rock-blasting is to make a cylindrical cartridge containing an annular cylindrical layer of powdered charcoal or mixture of petroleum and kieselguhr held in place by gauze. The cartridge case is made of cardboard, and it is fitted at each end with a cork. The liquid oxygen is introduced by a papier-maché tube which passes through one of the corks.



SECTION OF THE "OXYLIQUIT" CARTRIDGE.

The liquid is distributed through a loosely fitting cylinder having large gauze ports, and it passes through this gauze into the absorbent combustible material. Vent-holes are provided, so that gasified oxygen may escape to the surface. This gas passes up an outer tube as shown in the illustration. The detonator is arranged at the bottom of the cartridge and the electric-firing wires are brought to the surface through the outer tube. The supply of liquid oxygen is brought to the bore-hole in a vacuum flask. This flask has a special stopper that will screw to a flexible iron tube connected with the papier-maché tube of the cartridge. The stopper is fitted with copper rings which serve to conduct heat from the atmosphere to the inside of the flask, and thus to evaporate sufficient of the liquid to serve to drive the rest into the cartridge. By this arrangement the oxygen can be driven along a hole in any direction.

On reading this account, a number of practical considerations will immediately arise in the minds of mining engineers. For instance, as the explosion must be brought about as soon as possible after the oxygen is introduced, it is impracticable to fire many shots in the same round, and the method would be unsuitable underground or in any other situation where a substantial amount of time is occupied in transferring the men to a place of safety. The method could, however, in some circumstances conveniently be used for quarrying or in the excavation of railway cuttings or foundations for buildings or other structures. The engineer will want to know the cost of the oxygen mixture as compared with an ordinary explosive, and he naturally does not relish the idea of having to manufacture his own explosive on the spot and to make his own charges as required. The danger of allowing the liquid oxygen to be enclosed after it leaves the vacuum flask, and the necessity for dashing to a place of safety and igniting the charge as rapidly as possible, are two factors causing substantial inconvenience. The question arises as to the minimum diameter of the hole necessary to accommodate a cartridge of the new composition equivalent to the standard strength. A hole of at least 2 inches diameter will be required, a size not conducive to economy in drilling. Another point is that to secure the safe placing of the cartridge, it is necessary that the hole shall be even and straight. The objection can be urged that the strength of the charge can only be regulated by the size of the one cartridge used in each hole, instead of by increasing the number of cartridges. If such variation in the strength of the charge is desired, it is necessary in the case of the new composition to have a variety of cartridges of different lengths, or to drill wider holes and have cartridges of varying diameters. But in any case the bulk of the cartridge lengthwise, as well as in diameter, required to produce a given effect is so much greater than when ordinary explosives are used, that its relative efficiency and the relative cost of drilling are very much against its adoption. The question of fumes emanating from this type of explosive has to be considered. It is claimed that the fumes are quite innocuous and not perceptible, but engineers who have had the opportunity of making independent investigations are far from corroborating this claim. The necessity for the hole to be dry is obvious, for any water present would be immediately frozen by the liquid oxygen, which would then be unable to mix with the organic material and no explosion would occur. To counter-balance the disadvantages, the Germans assert that the cost of "oxyliquit" is a quarter of that of blasting gelatine, but the conditions assumed in making this estimate must be known before the figure can be accepted as a guide. It is stated also

that the strength of the explosion obtained lies between those of blasting gelatine and gelignite. One advantage that may be rightly urged in favour of this method is the absence of danger from misfires, for in case the detonator fails the charge soon becomes harmless owing to the evaporation of the oxygen. We have in the above description indicated the principle of the method, and have weighed some of the advantages and drawbacks. Our readers will probably agree with the view expresed in our opening words, and will judge the value of the process to be political rather than industrial.

PIPING FOR HIGH PRESSURE GAS TRANSMISSION

BY S. LORD.*

In the matter of strength, present-day demands require a very high standard. Coal-gas lines use what are called high pressures, but their range is never up to 100 lb. Natural gas pipe lines are laid in small sizes near the wells to control pressure up to the limit of the rock pressures, which in some cases run up to 1,200 or even 1,400 lb. The small lines carrying such pressures to the nearest gate or reducing station hold against breakage very successfully, but the frosty couplings show very clearly the expansion of leaking gas. Fortunately, these extreme pressures are never carried any distance from the well, or for any length of time, without natural reduction due to expansion into the large space of a big pipe line. Main lines of large size are now in fairly common use, carrying pressures up to 350 or 400 lb., and it is necessary that such joints be bottle-tight under such conditions. It is no simple proposition to confine gas at such a pressure in a pipe of 20 in. diameter, but coupling manufacturers have solved that question fairly well. Oil lines of 10 in. diameter now work continuously at pressures up to 700 lb., while in 6-in. and 8-in. trunk lines crossing the greater portion of the continent, pressures run up to 900 lb. Many gas engineers believe that pressures between 500 and 800 lb. will soon be used on large transportation lines, since the most economical way to carry a large volume of gas is to keep it at a very high pressure. Boosting pressures from 100 to 300 lb. have enabled gas companies greatly to increase the carrying capacity of their lines. Boosting to 600 lb. and continuing to boost whenever there is a slight fall in pressure will work wonders where the lines are sufficiently long to carry the system out with economy. It is easy to appreciate the strength required in pipe couplings to hold without any leakage the hundred or more million cubic feet that a large line will carry under such conditions.

*Engineers' Society of Western Pennsylvania.

HOW AIR SHOCKS KILL IN THE TRENCHES*

After each of the recent battles it has been shown that, although most of the bodies bore traces of projectiles, there were others without apparent wounds, that preserved the attitude in which they were at the moment of death. It was generally admitted that these died of shocks, from an instantaneous stoppage of the circulation; but no further explanation was possible.

This was the state of affairs when M. Arnoux told at a meeting of the French Society of Civil Engineers how a French officer at the front had found a pocket aneroid barometer which had been put out of commission by the nearby explosion of a German shell. Its stoppage was found to be due to the fact that one of the levers for transmitting the movements of the aneroid box to the pointer, which normally rests on the other lever, had passed beneath it. This could only have been due to abnormal inflation of the box, caused by a considerable barometric depression.

The two levers were replaced in normal position, and the machine was placed under the bell of an air pump. By lowering the pressure little by little, the experimenter showed that one lever shipped under the other when it reached a degree of exhaustion about equal to that at the top of Mount Blanc, at the elevation of 15,000 feet.

We may logically conclude, then, that the explosion of the shell caused a brief barometer depression corresponding to the pushing back of the air at a rate of about nine hundred feet per second. Under such a pressure all nearby objects are thrown down and all living beings are physiologically destroyed

**La Nature*, Paris.

by the violent displacement of the air, while those sheltered behind any obstacle can be affected only by the static lowering of pressure in the surrounding atmosphere.

Now, the effects of lowering the barometric pressure have been observed in aeronautics, when a too-rapid ascent has occasionally been fatal. We know that the blood holds in solution air and carbonic acid, in larger proportion as the pressure is higher, and that these gases separate out as bubbles when the pressure is lowered, precisely as happens when a bottle of soda water or champagne is opened. In this case the bubbles escape from the bottle, but in the human body they are caught in the capillaries, where they stop the circulations of blood instantly.

The phenomenon is dangerous only when the lowering of pressure is very sudden, for the bubbles are dangerous only when they are large enough to obstruct the capillaries. Death is said to occur from "gaseous embolism."

The effects produced by shell explosion have thus been long familiar in other fields. Observed in aeronautics, they are also known among workmen engaged in tunneling. Working at depths of 75 to 100 feet, and thus subjected to pressure of two and one-half to three atmospheres, their return to normal pressures must take place very slowly, to enable the gas in the blood to escape in small bubbles.

In case of violent increase and decrease of pressure produced instantaneously by explosion, gaseous embolism affects all the blood vessels in the organism and instantly arrests all muscular action. This is why soldiers thus attacked preserve the attitude in which the double phenomenon has surprised them. Death occurs with lightning rapidity.

COMPARATIVE TESTS OF ROCK DRILLS

The driving of the Wilson Avenue, Chicago, 8 mile waterworks tunnel under the direction of John Ericson, city engineer, with Henry W. Clausen, engineer of construction in direct charge, afforded an opportunity for comparing the performance of different types of rock drills, and a summary of the results obtained was embodied in a recent paper by Mr. Clausen before the Western Society of Engineers.

It was decided that the best way to determine the most efficient type and make of drill for any particular rock formation would be to equip the different shafts with drills representative of the different types. Accordingly the old piston type of drill, the water-piston type and the water-hammer type were used.

The results found up to Jan. 1, 1916, were that the most economical type of drill from the standpoint of repair parts is the piston. The fastest drill is the water-hammer drill, but the difference between the drills is not marked in either comparison. The hammer drill, however, uses less air than the piston drill.

The specifications called for drills with not less than 2⅝-in. cylinder diameter and a capacity of 10-ft. holes. The cost of the better grade of piston drill of this size was given as $193, of the water-piston drill, $229.60, and of the water-hammer drill, $280; all equipped complete with a 50-ft. length of hose.

Both the column and heading-bar methods of mounting the drills at the face were tried, and the advantage thus far seems to rest with the column method. Bench holes were drilled from the column or bar as much as possible.

THE LEYNER DRILL SHARPENER.

After the tunnel work had advanced for some time it was found advisable to install a No. 5 Ingersoll-Rand Leyner drill sharpener with the necessary dies, dollies, etc. This machine, which is operated by compressed air, holds and forges the steel. The cost of the machine with all appliances was $1,379.55. It is operated by one man and easily performs the work of four blacksmiths and does the work better, said Mr. Clausen.

NOTES

According to a trade circular, "Blow Guns," are used for cleaning type, electros, wood cuts, newspaper plants and *magazine publishers.* [Our italics. Ed. C. A. M.]

Notwithstanding the everlasting mixup in Mexico, The Mexican Mining Journal for May comes to us on time, beautifully printed, filled with excellent matter and giving every evidence of confident life. The Journal has opened a branch office at Tampico, Mexico, the center of what are said to be the world's greatest oil fields, and hereafter it will publish a special oil section which will cover this important branch of the Mexican Mining industry.

The heaviest substance known is osmium, which has, bulk for bulk, nearly twice the weight of lead. The specific gravity of gold is about 19¼, while that of osmium is nearly 22½.

Mexico, despite the deplorable conditions existing, is exporting more silver to the United States than for the last 20 years. It comes from the San Luis Potosi district, from which place over 8 tons were imported in 2 months.

The Ford Motor Car Co. built 58,329 cars in the month of March, the largest production record in its history. On March 25, the company turned out 2,763 cars, the largest day's production. This was at the rate of nearly two a minute for twenty-four hours.

According to an Austrian railway paper the railways in the countries of the Central Powers have substituted metallic flexible connections for the rubber hose used for continuous brakes, and steam-heating apparatus and a coal tar oil for lubricating the axles of rolling stock. The latter is made principally from anthracene, and is in various grades of viscosity, according to the purpose for which it is to be used.

H. W. Bailey, Mutual Life building, Seattle, is testing and developing a dry concentrating machine, in the operations of which compressed air is employed instead of water. He expects to have some practical tests made in the field.

Over three and a half million tons of cherry pits are thrown away at the canning establishments of this country. This would make 200 tons of fixed oil worth $80,000, 6,000 pounds of volatile oil worth $60,000 and 350 tons of meal, worth $14,000; a total of $154,000, besides more than 5,000 gallons of pure alcohol, 20,000 gallons of syrup or 85,000 gallons of jelly. A factory in Oregon is planning to utilize these waste pits.

An ingenious, although simple, application has been found for electric fans in winter for improving both the warming and ventilation of rooms. The fan is so placed as to throw a current of air on the lower part of a steam radiator, which results in the heating of a much greater volume of air than would take place under ordinary circumstances in an equal interval of time. This use of the fan also induces a circulation of the air that tends to improve the ventilation.

Changes in the conditions governing the use of gas for domestic purposes have caused the New York Public Service Commission to consider altering the method of testing it, on the grounds that modern appliances require that gas should have a heating value only, and that the present candle-power standard was a hindrance to distribution without corresponding advantages, in that it increased the cost because of the rising price of the enriching oils that had to be added, and the present standards were wasteful and burdensome both to the consumers and to the companies.

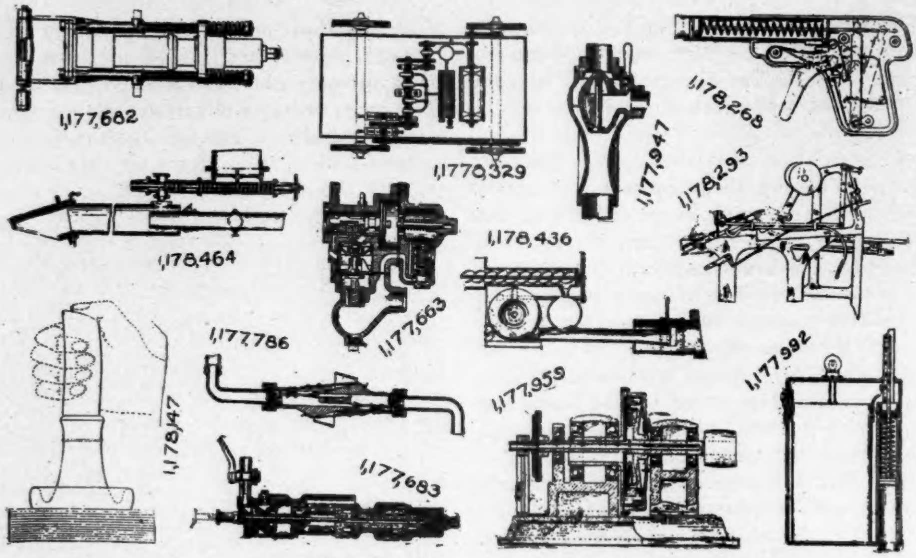
The Union Carbide Company, Niagara Falls, has started the erection of a large calcium carbide plant at Saude, about 60 miles from Bergen, Norway. The plant will buy its power from the Aktieselskabet Saude Faldene, and the power is to be furnished beginning Jan. 1, 1918. At first 20,000 hp. will be used. This will later be increased to 40,000 hp.

The steel industry is one industry in which for nearly ten years the only change in wages has been a movement upward. These advances have been as follows:

Jan. 1, 1907	7 per cent.
Jan. 16, 1910	6¼ per cent.
Feb. 1, 1913	10 per cent.
Feb. 1, 1916	10 per cent.
May 1, 1916	10 per cent.

As in each case the percentage of increase has been applied upon the rates in effect at the time, the total increase since Jan. 1, 1907, has been 43¼ per cent.—*Exchange.*

As we figure the above, the actual percentages added to the original 100 per cent. were, successively, 7, 6.69, 11.36, 12.5, and 13.75, making a total of 51.3 per cent., instead of 43¼.



PNEUMATIC PATENTS APRIL 4.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

APRIL 4.

1,177,663. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

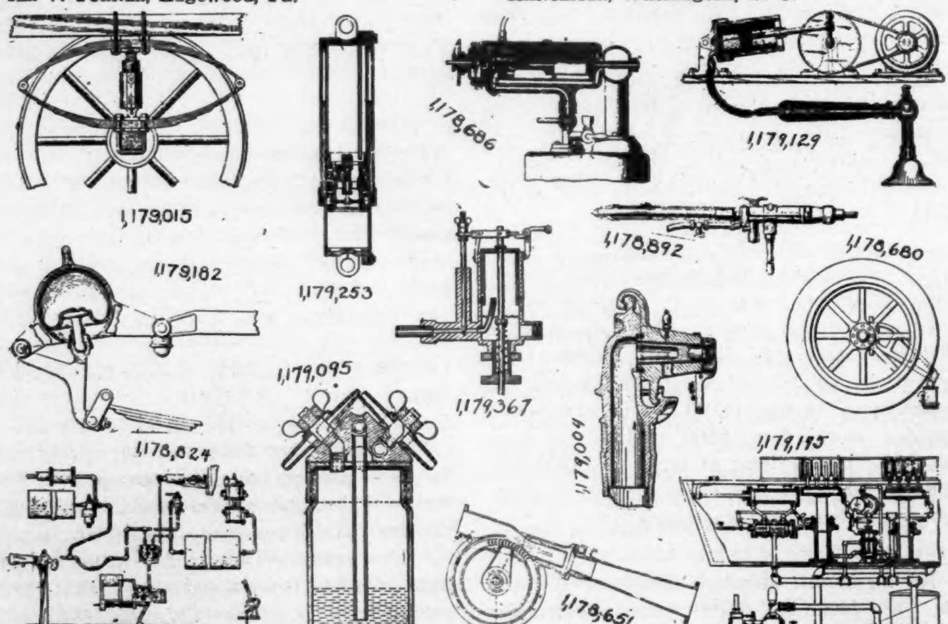
1,177,682. PNEUMATIC - TOOL HANDLE-MOUNTING. OMAR E. CLARK, Denver, Colo.

1,177,683. ROCK-DRILL. OMAR E. CLARK, Denver, Colo.

1,177,714. SUCTION-ERASER FOR BLACK BOARDS. GEORGE P. LULL, Bradford, Pa.

1,177,786. AUTOMATIC AIR-BRAKE COUPLING. GEORGE T. MCMILLAN, Bushnell, S. D.

1,177,947. INJECTOR FOR VACUUM CLEANING AND OTHER PURPOSES. EDWARD R. HANGLITER, Washington, D. C.

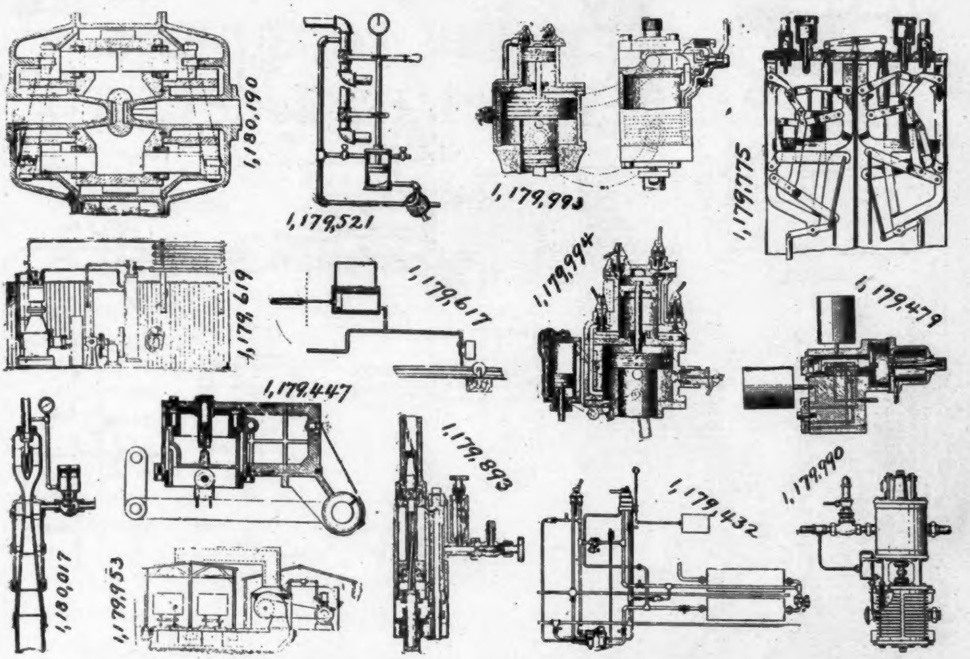


PNEUMATIC PATENTS APRIL 11.

1,177,959. AIR-COMPRESSOR. George C. McFarlane, Denver, Colo.
1,177,992. PRESSURE GAGE OR INDICATOR. Charles A. Clouser, New Smyrna, Fla.
1,178,122. TIRE-PUMP. Louis A. Andrews, Newton Upper Falls, Mass.
1,178,147. VACUUM LIFTING DEVICE. James Gardner, College Hill Borough, Pa.
1,178,268. AIR AND POP GUN. William F. Schmidt, Detroit, Mich.
1,178,293. PNEUMATIC PILE - FEEDER. Georg Brandstetter, Hohènstadt, and Richard Freund, Vienna, Austria-Hungary.
1,178,329. PNEUMATIC SPRAYER. William A. McWilliams, Oakland, Cal.
1,178,436. FEEDING AND BURNING FINE FUEL. Walter D. Wood, New York, N. Y.
1,178,464. BURNING PULVERIZED FUEL. Henry R. Barnhurst, deceased, Catasauqua, Pa., by Henry G. Barnhurst, administrator, Catasauqua, Pa.

1,179,004. VALVE FOR RAILWAY AIR-BRAKE SYSTEMS. Abram Hall, Denver, Colo.
1,179,015. PNEUMATIC LOAD-COMPENSATOR FOR MOTOR-DRIVEN VEHICLES. John Thomas McCrosson, Honolulu, Hawaii.
1,179,095. PNEUMATIC SPRAYER OR AIR-BRUSH. Burton P. Hall, Fanwood, N. J.
1,179,129. SUCTION AND COMPRESSION CUPPING APARATUS. Joel A. Maxam, Idaho Springs, Colo.
1,179,182. PNEUMATIC SPRING FOR VEHICLES. Josef Hofmann, Baumaroche, Switzerland.
1,179,195. BOTTLE-WASHING APPARATUS. William Le Brocq, New York, N. Y.
1,179,253. FLUID-PRESSURE DEVICE. George Westinghouse, Pittsburgh, Pa.

1. A cushion device comprising a cylinder, a plunger fitted to slide within said cylinder to permit variations of the volumetric capacity thereof,



Pneumatic Patents April 18.

APRIL 11.

1,178,618. AIR-GOVERNOR AND EXPRESSION DEVICE FOR MUSICAL INSTRUMENTS. William F. Bayer, Buffalo, N. Y.
1,178,651. PUMP. Maurice Leblanc, Paris, France.
1,178,680. PNEUMATIC - TIRE - PROTECTIVE MAGNET. David Rosenthal, Boston, Mass.
1,178,686. AUTOMOBILE-TIRE PUMP. Frank C. H. Strasburger, Knox, Ind.
1,178,695-6. FLUID-MOTOR. Henry W. Yost, Springfield, Ohio.
1,178,703. PNEUMATICALLY - OPERATED ELECTRICAL SWITCH. Jacob F. Bentz and John A. Sertl, Schenectady, N. Y.
1,178,824. AUTOMATIC RAILWAY SAFETY APPLIANCE. Joseph F. Seibold and George H. Leppert, Jr., Indianapolis, Ind.
1,178,892. ROCK-DRILL. Daniel S. Waugh, Denver, Colo.
1,178,978. COMPRESSOR-VALVE. Charles Wainwright, Erie, Pa.

a main packing for the sliding joint between the plunger and the cylinder, a supplemental packing for said joint on the low pressure side of said main packing, in combination with means for applying suction to the sliding joint between said packings.

1,179,367. AIR-MOISTENER. William Wyand, Absecon, N. J.

APRIL 18.

1,179,432. FLUID-PRESSURE BRAKE SYSTEM. James A. Hicks, Atlanta, Ga.
1,179,447. PNEUMATIC MEANS FOR MOUNTING CARRIAGES ON WHEELS. Henri Mercier, Paris, France.
1,179,479. FLUID-PRESSURE BRAKE. Walter V. Turner, Edgewood, Pa.
1,179,521. SPEED-CONTROLLING DEVICE. Hedley C. W. Graham, Rochester, N. Y.
1,179,526. PROCESS OF PRESERVING A CORPSE. Leonidas R. Houchens, Fairfax, Va.

The process of preserving a corpse which consists in placing the body in a permanent casket having a cover adapted to be hermetically sealed, sealing said cover, withdrawing the air from the casket, supplying antiseptic gas to replace the air, and then permanently sealing the casket.

1,179,582. PNEUMATIC FOR PLAYER-PIANOS. WILLIAM T. WAITE, Laporte, Ind.

1,179,617. TRAIN-CONTROLLING APPARATUS. ISAAC P. DRAWBAUGH, De Queen, Ark.

1,179,619. COMPRESSOR. PAUL R. FOWLER and JOHN A. GINGRICH, Brownwood, Tex.

1,179,649. PNEUMATIC BED FOR LEATHER-WORKING MACHINES. OSCAR REIRSON, Peabody, Mass.

1,179,775. PNEUMATIC PUMP. MARTIN S. SWANSTROM, Chicago, Ill.

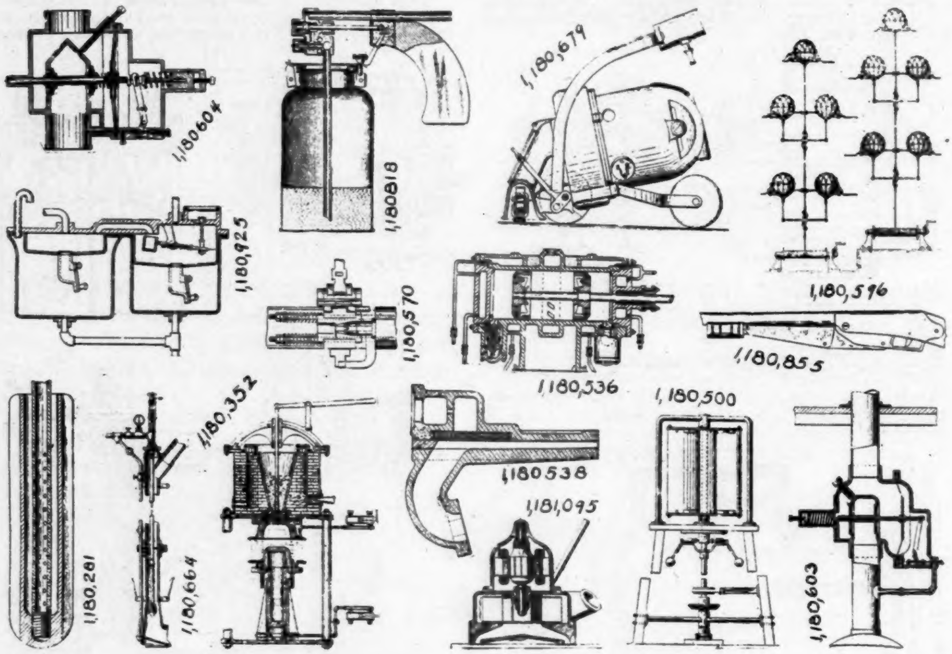
1,180,536. ICE-MACHINE COMPRESSOR. HENRY D. POWELL, Canton, Ohio.

1,180,538. LIQUID-FUEL BURNER. CHARLES RADIGUER, St. Denis, France.

1,180,570. DRILL-SHARPENING MACHINE. CHARLES CHRISTIANSEN, Gelsenkirchen, Germany.

1. In a drill sharpening machine, means for holding the drill, a pneumatically actuated matrix adapted to engage the cutting end of the drill, a yieldingly mounted forging-die inclosing said end movable in one direction by the matrix, and means to move said die against the action of the matrix.

1,180,596. AIR-MINES AGAINST ATTACK FROM AIR-CRAFT. PARCUS MCKINNEY, Los Angeles, Cal.



PNEUMATIC PATENTS APRIL 25.

1,179,893. PNEUMATIC IMPLEMENTS. MYRON F. BUCKMAN, Seattle, Wash.

1,179,953. THAWING APPARATUS. WALTER S. NEWHALL and SCOTT W. LINN, Cleveland, and ALVA C. HEZLEP, Miamisburg, Ohio.

1,179,990. LUBRICATOR FOR AIR-COMPRESSORS. ORVILLE C. WRIGHT, Fort Wayne, Ind.

1,179,993-4. FLUID PULSATING DEVICE. ALBERT BALL, Claremont, N. H.

1,180,017. VACUUM-JET. THOMAS L. DAVENPORT, Everett, Wash.

1,180,190. ROTARY PUMP AND BLOWER. JAMES ROBERTSON, Leytonstone, England.

APRIL 25.

1,180,281. AIR-LIFT PUMP. JOHN R. BROWN, Oil City, La.

1,180,352. VACUUM MOLDING - MACHINE. CONRAD WERRA, Waukesha, Wis.

1,180,355. AIR-OPERATED CHUCK. LEE M. WHITE, Detroit, Mich.

1,180,430. AIR-THRUST PROPELLER FOR BOATS. CHARLES EDWARD RIEDEL, Detroit, Mich.

1,180,500. WIND-WHEEL. JOHN W. ILEY, Farmers Branch, Tex.

1,180,603. PNEUMATIC - DESPATCH - TUBE APPARATUS. EMMETT B. PERRINE, Chicago, Ill.

1,180,604. PRESSURE - ACTUATED PNEUMATIC TRANSMISSION APPARATUS. EMMETT B. PERRINE, Minneapolis, Minn.

1,180,664. PNEUMATIC PUMP-DREDGE. WILLIAM J. LITTLEHALES, Dickinson, N. D.

1,180,679. VACUUM - CLEANER. ARTHUR THOMPSON, Brookline, Mass.

1,180,744. PROCESS AND APPARATUS FOR SUPPLYING AIR AND OXYGEN OR THE LIKE TO INDEPENDENT DEEP-DIVING APPARATUS. HERMANN STELZNER, Lubeck, Germany.

1,180,818. SPRAYING APPARATUS. FRANKLIN F. BRADLEY, Chicago, Ill.

1,180,855. SPRING AIR-GUN. CHARLES F. LEFEVER, Plymouth, Mich.

1,180,871. PNEUMATIC ACTION FOR PIANOS. AUGUST NORDEEN, Connersville, Ind.

1,180,925. LIQUID-ELEVATING DEVICE. WEBB JAY, Chicago, Ill.

1,181,095. SUCTION-CLEANER. JOSEPH H. TEMPLIN, Philadelphia, Pa.

1,181,100. PNEUMATIC VEHICLE-WHEEL. JACOB H. FAWKES, Portland, Oreg.